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SURGERY, GYNECOLOGY AND OBSTETRICS

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THE END-RESULTS IN NEARLY THREE HUNDRED CASES IN WHICH THE GALL BLADDER WAS DRAINED—NOT REMOVED

BY H. LAURAN DARNER, M.D., BALTIMORE

WITH AN INTRODUCTION BY THOMAS S. CULLEN, M.D., F.A.C.S., BALTIMORE

From the Gynecological Department of the Johns Hopkins Hospital and the Johns Hopkins Medical School

TWENTY years ago there was much discussion as to when to operate and when not to operate in acute appendicitis. A wide difference of opinion also existed as to what should be done when a co-existent peritonitis was present. The subject was thrashed out at medical meetings and in the literature for several years, with the result that there is now a pretty general unanimity of opinion as to just what procedures are indicated in the various stages of appendicitis.

What applied to appendix operations two decades ago holds good to some extent for gall-bladder operations today. In the beginning nearly all gall bladders were drained. Later it was found that some of these patients suffered from a return of their gall-bladder infection or more stones developed, necessitating a second operation, so that very naturally the question arose: "Why not remove the gall bladder at the first operation and prevent further trouble?" And so firmly convinced were some surgeons that this was the proper procedure that they resected the gall bladder in nearly every case in which they found trouble. In many clinics this has become the routine procedure, and yet in the minds of many surgeons there has been a lurking suspicion that cholecystectomy might not be the wise thing in all cases, but that each case should be judged on its merits. Hence, there is now a tendency on the part of many in some cases to drain and in other cases to remove the gall bladder.

A follow-up of the cases has clearly demonstrated that a certain percentage of patients will have subsequent trouble no matter whether the gall bladder has been drained or whether it has been removed.

Cholecystectomy on a patient who is in good condition certainly gives brilliant immediate results, and furthermore it eliminates the postoperative drainage which for a few days may be so abundant that the dressings are continually soaked, causing great discomfort.

In many of my early cases the gall bladder was so firmly glued to surrounding structures that its removal was impossible, and in quite a number of cases where it was gangrenous I was afraid to attempt a cholecystectomy, feeling that it was unwise to dissect inflamed tissues and leave raw areas through which the infection might readily be disseminated. In such cases I limited myself to cutting away the gangrenous area and then draining. These patients, unless desperately ill at the time, promptly recovered and the majority of them remained well.

Bearing these cases in mind I contented myself with drainage of the gall bladder instead of removal. Of course, when the gall bladder was very large the major portion of it was cut away prior to introduction of the tube. In a no small percentage of the cases I felt that the drainage of bile, particularly where there was thickening and induration in the region of the pancreas, was almost as important as the removal of the gall stones. Nor could I quite get away from the feeling that it was probably unwise to remove the only switch from a single track road. This "switch" might be very valuable for anastomosis into the stomach or duodenum should the main line subsequently become blocked.

Some 2 or 3 years ago I felt it would be wise to take stock and see just what had been accomplished in our drainage cases. Dr. Darner went over my case books and found records of 296 cases. Six of these were ruled out, as a cholecystectomy had been done on account of the possibility of cancer. As will be learned from Dr. Darner's paper, in 17 the gall bladder was gangrenous, in 104 the process was acute, in 144 relatively quiescent at the time of operation, and in 25 the condition was found when the abdomen was opened for some other lesion.

Dr. Darner was indefatigable in his endeavors to trace all these gall-bladder patients, and in all but 14 cases he was successful.

His tabulation shows that 29 patients died shortly after operation, 14 were not located, 19 were unimproved, 26 were markedly improved, but had some symptoms, while the remaining 202 had had no gall-bladder symptoms after operation and were either well or had died of some other disease, the nature of this disease being specified in nearly every case.

Of the 29 immediate deaths, as shown by Dr. Darner's table, 17 were due to desperate complicating pre-operative conditions. This leaves 12 cases, 4.14 per cent, in which death was due to unlooked for postoperative complications. Under "patients that recovered but were not benefited by operation" Darner records 19 patients, 16 of whom I had operated upon. In the remaining 3 the first operation had been performed elsewhere. A perusal of this portion of the paper will give the reader a clear idea of the cases in our series in which drainage of the gall bladder was a failure.

As our series embraces a period of 25 years, we should naturally expect a number of deaths during this long interval. Thirty-four patients died from causes in no way associated with the previous gall-bladder trouble. This is clearly shown in Dr. Darner's tabulation.

There are living at the present time

Unimproved	16
Improved	26
Well	168
	210

Dr. Darner in his article has aimed to give the exact facts so that, after going through the individual protocols, the reader may judge for himself just what has been accomplished. He has in the main refrained from making any deductions.

I hope that all surgeons will shortly report their end-results in their gall-bladder cases. Of course, in clinics in which many acute gall-bladder infections are encountered, the immediate mortality will be infinitely greater than in those where quiescent cases supply the bulk of the operations.

In due time we shall get the proper perspective and be able to determine with some degree of accuracy when to drain and when to remove the gall bladder.

It is perfectly clear that the subject is not yet settled. I personally am deeply interested in this question from the standpoint of the patient. In 1915 I had my own gall bladder drained after removal of a large number of stones from the gall bladder and cystic duct. Later on more stones formed and the gall bladder was excised (February 28, 1923).

In conclusion I want to express my sincere thanks to Dr. Darner for his painstaking labor in locating and analyzing such a large percentage of my gall-bladder cases.

THE purpose of this paper is to present the postoperative results in a large series of gall-bladder conditions. The cases in this series include only those in which the surgical procedure consisted in drainage of the gall bladder. No attempt will be made to discuss the symptoms nor shall we give any review of the voluminous literature on the subject.

Every patient in this series was operated upon by Dr. Thomas S. Cullen. The cases studied cover a period of about 25 years. The ultimate results have improved year by year, thanks to our increased knowledge of the subject and to further refinements in the operative technique. The series being from the operative service of one and the same person will naturally give more uniform results than if the operations had been performed by various surgeons.

In the past 25 years (to July, 1921) Dr. Cullen has had 296 operative gall-bladder cases. The major portion of these operations were performed at the Church Home and Infirmary in Baltimore, the Cambridge, Frederick, and Hagerstown hospitals. Of the 296 operations, 6 must be ruled out because in these malignancy was suspected and the gall bladder with or without a wedge of liver was removed. The remaining 290 cases may be divided into the following groups:

	Cases
1. Acute gangrenous cholecystitis	14
2. Acute gangrenous cholecystitis, ruptured	3
3. Chronic cholecystitis and cholelithiasis (acute exacerbation)	104
4. Patients who had had frequent typical gall-bladder attacks but in whom the gall-bladder condition was quiescent at the time of operation	144
5. Cases in which gall stones were detected at the time of a pelvic operation or in the course of an appendectomy	25
	290

Now and then the pelvic or the appendix symptoms are so marked that other abdominal lesions are for the time being overshadowed and the operator is somewhat surprised to find gall stones in addition to what he is looking for. In questioning these patients afterward, some of them give a history of definite gall-bladder symptoms in years past. It is quite possible that of the 25 patients whose gall-bladder conditions are tabulated as accidental findings, some at least had had symptoms in years gone by.

Fig. 1. The gall bladder held open.

METHOD OF DRAINING THE GALL BLADDER

Dr. Cullen has all along felt that it was very essential to drain the gall bladder in such a way as to leave a minimal chance for the formation of postoperative adhesions. In the main he has followed the technique graphically shown by Mr. Broedel in the accompanying pictures.

In Figure 1 we see the gall bladder being held open with forceps. In Figure 2 the rubber tube is being sutured into the gall bladder; mattress or whip-over sutures of fine or medium plain catgut are used and the needle goes through into the lumen of the rubber tube. After the edge of the gall bladder has been whipped over all the way round, we have the picture indicated in Figure 3. A purse-string of catgut passing through the outer walls of the gall bladder is now placed, as shown in Figure 4. After this is tied, we have the picture shown in Figure 5—the tube fitting snugly into the gall bladder with only one catgut ligature visible.

Two flat cigarette drains are placed just below the gall bladder. The gauze does not come quite to the end of the drain. This minimizes the possibility of the drains becoming adherent and causing the patient unnecessary pain when they are removed. One flat drain is taken out on the second day, the other on the third day. The tube usually comes away between the tenth and thirteenth

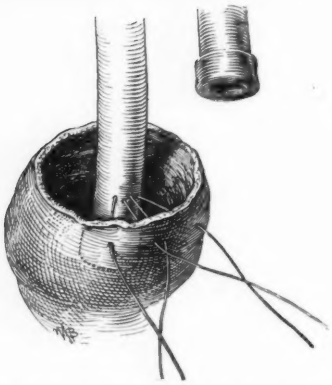

Fig. 2. Suture of the rubber tube into the gall bladder. As small a tube as is deemed safe is employed. Its end is rolled back, as indicated in the upper sketch, and with whip-over or mattress sutures the cut edge of the gall bladder all the way around is controlled. Each suture or every other one goes through the lumen of the tube.

days. The finer the catgut used, the sooner the tube becomes free.

With this technique there should be few adhesions. Of course, it is not always possible to make this ideal closure of the gall bladder. The abdominal wound is usually healed at the end of the third or fourth week.

FINAL RESULTS

Letters were sent to the patients, to their physicians, or to their relatives, and we were fortunate in getting definite data relative to all but 14 patients. In brief, the results were as follows:

		Cases
Immediate deaths		29
Patients not located		14
Unimproved by drainage—treated subsequently—		
Not operated on second time	6	
Cholecystectomy with death	3	
Cholecystectomy with no improvement	1	
Cholecystostomy, not improved	3	
Cholecystostomy, improved	2	
Cholecystostomy, well	4	19
Markedly improved		26
Well, or free from gall-bladder symptoms until death from some other disease		202
		290

IMMEDIATE DEATHS

The immediate death rate was 10 per cent (29 cases). By this we mean that of all the patients, regardless of their pre-operative condition, who had cholecystostomy performed, 29 died in the hospital. Our tabulation of deaths makes clear the cause of so heavy a death rate. When one considers the desperate pre-operative condition in 17 of the cases, this is by no means excessive. In 11 of these 17 cases there were pre-operative complications which made the prognosis bad, while in the other 6 there was inoperable malignancy and the operation was merely palliative for relief of obstruction. This leaves only 12 cases, 4.14 per cent, in which death was due to unforseen postoperative complications.

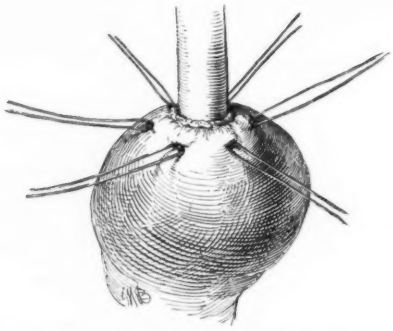

Fig. 3. The rubber tube sewn into the gall bladder.

PRE-OPERATIVE COMPLICATIONS RESPONSIBLE FOR DEATH

		Cases
Endocarditis and septicæmia (streptococcus viridans)		1
Hypertrophic cirrhosis of liver		1
Acute pancreatitis with fat necrosis and ascites		1
Diabetes mellitus		1
Acute cholecystitis, ruptured, general peritonitis		1
Cardiorenal conditions		6
Carcinoma, inoperable (palliative operation for relief of obstruction)		
Carcinoma of pancreas	3	
Carcinoma of gall bladder	2	
Carcinoma of pylorus	1	6
		17

POSTOPERATIVE COMPLICATIONS CAUSING DEATH

Cardiac failure	3
Pulmonary emboli	2
Septicæmia	1
Postoperative shock	3
Postoperative pneumonia	1
Exophthalmic goiter	1
Acute hernia	1
	12

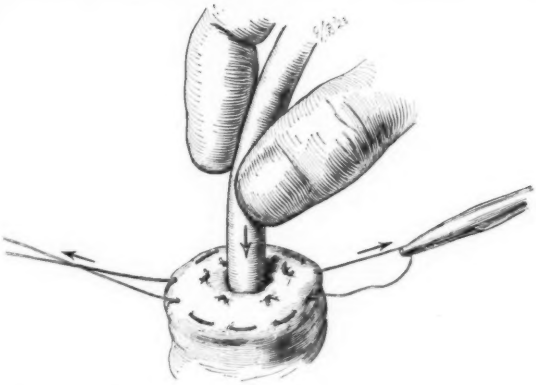

Fig. 4. Placing the purse-string suture around the tube in the gall bladder.

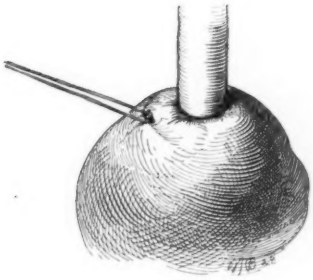

Fig. 5. The appearance of the rubber tube in the gall bladder after the purse-string suture has been tied.

It may be interesting to review the cases included in the tabulation which show the pre-operative complications which were responsible for death.

CASE 1. Dr. C. A. P. May 12, 1919. The patient had been ill for a month before the gall-bladder condition developed. During this time both Dr. L. F. Barker and Dr. William S. Thayer had seen him and a diagnosis of streptococcus viridans endocarditis and septicæmia was made. Blood cultures had been repeatedly positive. One month after the onset of this condition the patient developed such excruciating gall-bladder symptoms that both the consultants advised a gall-bladder operation despite the grave prognosis. At operation numerous stones were found, several of which were incarcerated in the cystic duct. The patient was much relieved for 6 weeks, but after this his condition became progressively worse and he died 7 weeks after operation. Death was thought to be due entirely to the streptococcus infection.

CASE 2. Mr. T. O. H. June 1, 1919. The patient had been quite ill for 8 months and recently had been using increasingly large amounts of morphine. The condition suggested a chronic cholecystitis and cholelithiasis with frequent exacerbations. At operation the gall bladder was found to be quite large and filled with tarry bile, but there were no stones. The liver was described as showing a most typical example of hypertrophic cirrhosis. The patient, who was in a desperate condition, failed to rally following operation and died 4 hours later.

CASE 3. Mrs. M. H. M. April 22, 1917. The patient had had diabetes for many years, but restricted diet had taken care of the condition very well. She had been acutely ill for only 24 hours and the operator in his pre-operative note said: "The patient reminds me of an acute pancreatitis I saw 25 years ago." At exploration 1000 cubic centimeters of straw-colored fluid escaped from the peritoneal cavity. Adipose tissue was dotted with tubercle-like areas of fat necrosis. The gall bladder contained large amounts of dark bile and stones. The patient rallied slightly but died about 15 hours after operation.

CASE 4. Mr. W. E. W. June 19, 1910. The patient had had severe diabetes for years, but for several days before he came to us had had excruciating gall-bladder pain with pyrexia and leucocytosis (white blood cells, 18,000). At operation an acute cholecystitis was found. He died 4 days later in diabetic coma.

CASE 5. Mrs. M. L. April 20, 1913. The patient had a severe acute nephritis at the time of operation.

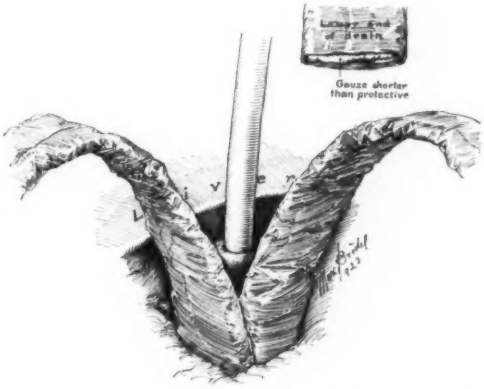

Fig. 6. Two flat cigarette drains laid below the gall bladder, one to be removed on the second the other on the third day. The gauze does not come quite to the edge of the drain. The drains overlap one another. In the picture they are drawn apart in order that their relation to the gall bladder may be seen.

The operation was undertaken on the advice of Drs. T. R. Brown and E. H. Gaither, who felt that it was the only hope of saving her life. There was quite an acute cholecystitis. The patient rallied well after the operation but died 37 days later with nephritis.

CASE 6. Mr. W. C. March 18, 1904. The patient had been sick for 3 weeks and at the time of operation there was evidence of a general peritonitis. The gall bladder had ruptured and there was about 300 cubic centimeters of turbid fluid in the peritoneal cavity. He died a few hours later.

CASE 7. Mrs. J. B. August 8, 1908. There was an acute gall-bladder condition with pyrexia and a leucocytosis. The patient had a severe acute nephritis at the time of operation. She died 3 days later in uræmic coma.

CASE 8. Mr. C. N. November 17, 1907. Acute cholecystitis and pancreatitis. Death from nephritis one day after operation.

CASE 9. Mr. W. C. V. October 29. 1908. Mitral insufficiency with partial cardiac decompensation. At operation there was an acute gall-bladder condition with pyrexia, leucocytosis, and jaundice. The abdomen contained 3 liters of bile-stained fluid. The gall bladder was acutely inflamed and six times the normal size. Death 3 days after operation of cardiac failure.

CASE 10. Mr. W. M. June 17, 1919. The patient had chronic nephritis. There was an acute gall-bladder condition at the time of operation, with many stones. There was an exacerbation of the renal condition after the operation. Death on the sixth day, probably due to cerebral hæmorrhage.

CASE 11. Mr. William H. R. June 21, 1920. The patient had a pre-operative cardiac and renal history. Gall-bladder symptoms had existed for 15 years. The present attack was of 3 weeks' duration; at operation 300 stones were found and perforation of the gall bladder. Death on the fifteenth day with a cardiorenal picture.

CASE 12. Mr. G. A. W. July 21, 1917. Operation for relief of obstruction of the common duct. Carcinoma of the head of the pancreas was found at operation. It had already completely obstructed the common duct and there were several nodules in the liver.

CASE 13. Mrs. M. M. July 14, 1911. Complete obstruction of the common duct. Large nodule in liver. Head of pancreas carcinomatous. Death a few weeks after operation.

CASE 14. Mrs. F. J. S. April 15, 1914. Carcinoma of the head of the pancreas with complete obstruction of the common duct. Death after 1 week from postoperative pneumonia.

CASE 15. Mr. J. R. January 3, 1907. Carcinoma of gall bladder found at operation with extension to liver and periportal lymph glands. Death 3 days after operation.

CASE 16. Mrs. E. M. H. July 19, 1917. The gall bladder had been drained and stones removed 12 years before. Recurrence of symptoms with considerable loss of weight. Carcinoma of gall bladder found at operation. Cholecystectomy. Local recurrence soon after operation and death followed.

CASE 17. Mr. E. H. January 3, 1913. An exploratory operation showed perforation through a carcinoma of the pylorus. Posterior gastro-enterostomy. Removal of stones and drainage of gall bladder. Death on the following day.

All of these 17 patients presented either an almost hopeless prognosis from the time they were first seen, or the operation was undertaken merely as a palliative measure.

A review of the cases with postoperative complications causing death, follows:

CASE 1. Mrs. J. C. T. November 24, 1909. Aged 59. Arteriosclerosis. She did well after operation but died shortly after leaving the hospital from "weakness."

CASE 2. Mrs. McA. October 30, 1909. Uncomplicated operation for stones. Following operation there was a cardiac break; death 6 days later.

CASE 3. Mrs. J. McC. December 14, 1903. Aged 62. Uncomplicated operation for stones. Cardiac decompensation on third day following operation. Death.

CASE 4. Mrs. C. E. F. April 23, 1917. A very fat woman. Forty stones found at operation. The gall bladder contained 100 cubic centimeters of viscid fluid Death 1 week after operation, the clinical picture suggesting a pulmonary embolus.

CASE 5. Mrs. R. C. A. May 13, 1919. Appendectomy and removal of gall stones. Death on the eighth day from pulmonary embolus confirmed at autopsy.

CASE 6. Mrs. F. W. McA. April 23, 1921. Acutely ill at time of operation. White blood cells 30,000. Temperature 102°. Gall bladder gangrenous, contained one large stone. Death 18 days after operation. The autopsy showed multiple lung and brain abscesses.

CASE 7. Mrs. E. C. November 22, 1904. The patient failed to rally after a gall-bladder operation. Death attributed to shock.

CASE 8. Mrs. J. H. February 27, 1910. Very ill at the time of operation. Temperature 104°. Pulse 150. White blood cells 30,000. History of pneumonia, 10 weeks before operation. The patient failed to rally after operation.

CASE 9. Mrs. W. B. B. May 15, 1914. Aged 55. Jaundiced for past 6 months. At the time of operation she had a bronzed color. Gall bladder markedly enlarged on palpation. Failed to rally after operation for removal of stones.

CASE 10. Mrs. W. February 6, 1904. Suspected rupture of the gall bladder. Stone removed from gall bladder. Ruptured right pus tube found. Postoperative pneumonia. Death on third day.

CASE 11. Mrs. H. H. W. April 1, 1918. The patient had a definite exophthalmic goiter. Definite gall-bladder symptoms with jaundice and clay-colored stools. Operation uncomplicated. Death in 4 weeks from thyroid intoxication.

CASE 12. Mr. J. H. February 17, 1910. Definite history. Stones found in gall bladder at operation. Patient discharged from hospital at end of third week. There was still a small drainage sinus at that time. During a paroxysm of coughing the incision broke down. His physician treated the protruding viscera with bichloride compresses. Neither the hospital nor the surgeon was notified. The patient soon died.

Of the patients who recovered but were not benefited by the operation, we find that 19 patients reported that their symptoms had not been relieved by the first operation. Thirteen of these have undergone subsequent gall-bladder operations while the remaining 6 have had only medical treatment. In these 6 cases the presence or absence of a gall-bladder lesion was questionable at the time of the original operation and exploration was only undertaken because of a definite pelvic condition or definite appendiceal symptoms and signs. Then through a McBurney or a mid line suprapubic incision the gall bladder was palpated and a definite lesion made out. Since operation in these six cases, the vague gastro-intestinal symptoms which were present before operation have not been relieved. The primary gall-bladder symptoms were never severe, and it was only the presence of another abdominal condition that caused the patient to submit to operation. Since operation these vague symptoms have returned, but they are not severe and are relieved by palliative measures.

Of the 13 remaining patients who have been operated upon more than once, the following 3 have been operated on, on the first and second occasion, by Dr. Cullen. One patient was operated on in 1911 at which time "marked twisting and kinking of the cystic duct" was noted. No stones were found, but the bile was "sandy" and bright yellow. The patient was perfectly well for 6 years after this operation, when she had a sudden acute gall-bladder attack. A second operation at this time revealed an acute cholecystitis. The duodenum was firmly adherent to the gall bladder and was perforated at one point during the release of these adhesions. This perforation was closed with difficulty because the tissues were so friable. No stones were found but a considerable amount of grumous material was obtained from the gall bladder. During convalescence, several small stones were expelled from the drainage tract. The patient made a rapid discovery and is well today, 5 years after her second operation. She is now 61 years of age.

The second patient was perfectly well for 2 years and then an acute empyema of the gall bladder developed. This was drained and the patient is now quite well 2 years after the second operation.

The third patient has had a definite recurrence of symptoms following the second operation.

There were three cases in which the first operation had been performed elsewhere and the second by Dr. Cullen. One of these patients had been operated on by another surgeon in 1916. Three hundred stones were found. Her symptoms returned 5 years later. Exploration at this time revealed additional stones, one of which was out in the peritoneal cavity completely walled off by omentum. Since the second operation 2 years ago the patient has been free from gall-bladder symptoms.

In a second case the cystic duct was found to be completely blocked by a large faceted stone. Since the second operation, 7 years ago, the patient has been free from symptoms except those referable to a small ventral hernia. The third patient has not been helped by the second operation.

Of the 7 remaining patients, other surgeons later removed the gall bladder from 4. We learn that 3 of these patients died soon after, before being discharged from the hospital, and the fourth patient claims that the symptoms have not been relieved by cholecystectomy. In the remaining 3 cases the gall bladder was drained. Two of these patients with gangrenous cholecystitis recovered and the third, while not well, has been markedly benefited. A summary of the 13 cases in which more than one operation has been done gives the following result:

SUMMARY OF THIRTEEN CASES OPERATED UPON MORE THAN ONCE

	Result
Three cholecystectomies	death
One cholecystectomy	not improved
Three cholecystostomies	not improved
Two cholecystostomies	improved
Four Cholecystostomies	well

Six had only medical treatment after the first operation—no subsequent operations

SUMMARY OF CASES UNIMPROVED BY THE FIRST OPERATION

A. Cases in which no subsequent operation was performed.

CASE 1. Mrs. M. P. January 30, 1919. Vague abdominal symptoms with tenderness over the appendix and gall bladder. No jaundice. Appendix removed through a McBurney incision. Stones were palpated in gall bladder. Right rectus incision. Stones removed and gall bladder drained. (Note from patient 3 years later that all symptoms had returned within the past week. Relieved completely by medicine.)

CASE 2. Mrs. H. H. G. June 13, 1919. Vague abdominal symptoms before operation. Cervical and perineal repair. Appendectomy and modified Gilliam suspension of uterus through mid line incision. Exploration of gall bladder revealed stones. Stones removed and gall bladder drained through right rectus incision. Abdominal symptoms have returned.

CASE 3. Mrs. W. B. November 16, 1918. Appendix history. Pain at times in gall-bladder region. Large boggy appendix removed through McBurney incision. Stones found in gall bladder on palpation. Stones removed, and gall bladder drained through right rectus incision. Patient has not been benefited.

CASE 4. Mrs. I. R. October 4, 1915. Repair of relaxed outlet and curettage. Myomectomy, modified Gilliam suspension of uterus and appendectomy through mid line incision. Gall bladder palpated and stones found. Stones removed and gall bladder drained through right rectus incision. Gastro-intestinal symptoms unimproved.

CASE 5. Mrs. W. W. D. July 5, 1917. Vague pre-operative gastro-intestinal symptoms, suggesting a lesion of the appendix or gall bladder. Left inguinal hernia repaired. Appendix removed through a McBurney incision. Gall bladder palpated. Stones found Stones removed, one from cystic duct, and gall bladder drained. Symptoms now as before operation.

CASE 6. Mrs. C. M. B. December 30, 1918. Pre-operative diagnosis of chronic appendix or chronic cholecystitis. Appendix adherent, removed through McBurney incision. Adhesions palpated about gall bladder. Gall bladder drained; no stones; adhesions released. Patient unimproved.

B. Cases in which there have been two or more operations.

CASE 1. Mrs. G. E. M April 24, 1911. (First operation, by Dr. Cullen.) Definite gall-bladder symptoms. Jaundice. Pyrexia. Right rectus incision. Gall bladder enlarged, marked twisting and kinking of cystic duct. Bile bright yellow and sandy. Gall bladder drained July 12, 1917. (Second operation, by Dr. Cullen.) (Interval note: Patient well until one week ago; then an acute attack of pain in gall-bladder region. No jaundice.) Exploratory gall-bladder incision. Gall bladder firmly glued to surrounding tissue; escape of grumous material. Duodenum firmly adherent to gall bladder and perforated at one point during separation of adhesions. Almost impossible to close this rent satisfactorily because tissues were so friable. Several drains over duodenum. No stones found. Gall bladder drained. Several passed through drainage tract during convalescence. Complete recovery.

CASE 2. Miss R. I. K. March 25, 1919. (First operation, by Dr. Cullen.) Appendectomy through McBurney incision. Several attacks of jaundice. Gall bladder found adherent on palpation. Gall bladder drained through right rectus incision. No stones found. March, 1921. (Second operation, by Dr. Cullen.) Acute empyema of gall bladder. Old scar excised. Gall bladder drained. Complete recovery.

CASE 3. Mrs. A. C. S. April 4, 1919. (Both operations, by Dr. Cullen.) First operation 1 year ago. Recurrence of symptoms. Right rectus incision. Omentum adherent. Gall bladder distended. Stones removed and gall bladder drained. The symptoms have not been relieved by second operation.

CASE 4. Mrs. W. D. June, 1916. (First operation, by another surgeon.) Three hundred gall stones removed and gall bladder drained. February 2, 1921. (Second operation, by Dr. Cullen.) Recent attacks with jaundice. Gall bladder explored, many stones found. Patient quite well since second operation.

CASE 5. Mrs. S. E. April 26, 1915. First operation some years ago. (Second operation, by Dr. Cullen.) Gall bladder adherent and small. One stone lodged in cystic duct. Patient free from symptoms. Small ventral hernia.

CASE 6. Mr. L. A. H. January 5, 1920. First operation 8 years ago, by another surgeon. (Second operation, by Dr. Cullen.) Gall bladder adherent. No stones found. Unimproved.

CASE 7. Mrs. J. N. July 6, 1916. (First operation, by Dr. Cullen.) Acute cholecystitis. Thirty stones and a considerable amount of pus in gall bladder. Symptoms returned and second operation for gangrenous cholecystitis, by another surgeon. Patient well since second operation.

CASE 8. Mrs. M. K. December 11, 1911. (First operation, by Dr. Cullen.) Gall bladder reached down to umbilicus. Walls thickened and omentum adherent. Two stones were firmly adherent in

cystic duct. (Second operation several years later, by another surgeon.) Stones of an entirely different type. Condition improved since second operation.

CASE 9. Mrs. F. S. January 3, 1918. (First operation, by Dr. Cullen.) Perineal repair. Appendix removed through McBurney incision. Gall bladder found to contain stones. Stones removed and gall bladder drained through right rectus incision. Recurrence of symptoms and second operation, by another surgeon. Patient well since second operation.

CASE 10. Mr. D. W. July 17, 1917. (First operation, by Dr. Cullen.) Appendix removed through McBurney incision. Stones removed from gall bladder and gall bladder drained. Patient unimproved. February 16, 1918. (Second operation, by Dr. Cullen.) Adhesions released and gall bladder drained. No stones found. Third operation, by another surgeon. Cholecystectomy attempted. Death 10 days after operation.

CASE 11. Mr. R. G. January 1910. (First operation, by Dr. Cullen.) A very fat man. Gall bladder distended, full of grumous material. Two small stones. Improved. Several years after symptoms returned. Cholecystectomy, by another surgeon. Death a few days later.

CASE 12. Mrs. F. B. D. June 13, 1904. (First operation, by Dr. Cullen.) Small gall bladder, containing 20 stones. Cystic duct 2 centimeters in diameter, plugged with small stones. Hepatic duct plugged with stones 1 centimeter in diameter. Drain left in hepatic duct. Second operation in February, 1921, by another surgeon. Gall bladder removed. Death after this operation.

CASE 13. Mrs. E. C. S. December 10, 1909. (First operation, by Dr. Cullen.) Seventy-five cubic centimeters of pus and 20 stones. Several stones in cystic duct. Patient unimproved. In June, 1921, second operation, by another surgeon. Cholecystectomy. Unimproved.

SUMMARY OF CASES MARKEDLY IMPROVED BY DRAINAGE OF THE GALL BLADDER

The following cases show that the patients have been much improved by the operation. Some occasionally have had abdominal distention or constipation. Others show some tenderness in the gall-bladder region. A few have had arthritis or neuritis and one has had jaundice without pain.

All of these patients seem to have been much better since the drainage of the gall bladder.

CASE 1. Mrs. McN. May 25, 1902. Symptoms for several years. Gall bladder adherent, large stone removed. Drainage tract remained open over 6 months. Incision became infected. Later the patient recovered completely and has had no return of symptoms for 17 years.

CASE 2. Mrs. R. G. May 3, 1907. Gall bladder colic for 3 months. Skin at time of operation bronze-colored. Gall bladder wall thickened and œdematous. Gall bladder and cystic duct filled with thick tarry material. Normal bile escaped after this was removed. The patient has had only one recurrent attack. This occurred about 1 year ago, and was relieved by palliative measures. No other attacks since.

CASE 3. Mrs. K. M. M. February 4, 1908. Chronic cholecystitis. Appendix removed. Fifty stones removed from gall bladder. Marked visceroptosis noted at operation. Recently she has been having gastro-intestinal upsets, intermittent attacks of diarrhœa and meteorism, with no localizing symptoms.

CASE 4. Mrs. S. C. April, 1908. Appendectomy. Fifty stones removed from gall bladder. She has a small ventral hernia which causes no symptoms. Developed multiple arthritic lesions 5 years ago.

CASE 5. Mrs. J. H. January 11, 1912. Typhoid fever at 15. Gall-bladder symptoms since then. Appendectomy. Fifteen stones removed from gall bladder. Her physician states that he is treating her for neuritis and "auto-intoxication." She is also receiving radium therapy for uterine malignancy.

CASE 6. Mrs. V. M. November 15, 1912. Symptoms for 12 years. Stones removed. Her physician states that patient is perfectly well, "fat as a pig." Slight recurrence of gall-bladder pain 1 year ago. No trouble since then.

CASE 7. Mrs. L. J. May 29, 1913. Stones removed. Her physician states that at times there is a great deal of pain and soreness in the gall-bladder region. Attacks are never severe.

CASE 8. Mrs. F. S. June 27, 1913. Symptoms for many years. Acute attack at time of operation. Stones removed from gall bladder and cystic duct. Common duct seemed quite indurated on palpation. She feels quite well when on a restricted diet. Being treated for neuritis at present time.

CASE 9. Mrs. J. N. H. May 23, 1914. Typical gall-stone attacks. Typhoid fever 10 years ago. Recent attacks accompanied by jaundice and clay-colored stools. Stones removed. She was well until 18 months ago. A few attacks of cramp-like epigastric pain in past 18 months. Not severe. Attacks relieved by palliative measures.

CASE 10. Mrs. N. L. March 11, 1915. Chronic cholecystitis. Appendectomy. Many stones and a considerable amount of putty-like material removed from gall bladder. She has had a few recurrent attacks recently. "Completely cured by 58 chiropractic treatments."

CASE 11. Mrs. M. J. March 16, 1916. Symptoms for years. Stones removed from gall bladder and cystic duct. No return of pre-operative symptoms, but she suffers from chronic constipation.

CASE 12. Miss M. E. May 26, 1919. Hysteromyomectomy and appendectomy through a mid-line incision. Gall-bladder drained through right rectus incision. Fifty cubic centimeters of putty-like

material and several stones removed. Gall-bladder wall quite thickened and friable. No recurrence of symptoms except flatulence. Health quite good.

CASE 13. Miss R. H. January 6, 1916. Typhoid fever 10 years ago. Several typical gall-bladder attacks in past 6 months. One large ball-valve stone removed. Two years ago she had a slight attack of gall-bladder pain lasting 1 day. No other attacks. Perfectly well at present.

CASE 14. Mrs. A. H. S. January 1917. Adhesions about gall bladder released. No stones. Gall bladder drained. The patient is perfectly well except for occasional slight discomfort along the right costal margin.

CASE 15. Miss O. B. June 16, 1917. Typical attacks. Appendectomy. Three hundred stones removed. "Two or three spells that I was afraid were attacks of gall stones but were not severe enough to call a doctor."

CASE 16. Mrs. E. M. U. October 15, 1917. Frequent typical gall-bladder attacks. Appendectomy. Release of adhesions about gall bladder. No stones. Gall bladder drained. No recurrence of pain. Frequent attacks of "gas accumulation."

CASE 17. Mrs. S. J. J. February 28, 1918. Midline ventral hernia following urinary bladder operation. Hernial sac resected. Gall stones removed. Much improved. Once in a while experiences sudden sharp pain in region of right costal margin.

CASE 18. Mr. N. S. W. July 9, 1917. Typical symptoms for 20 years. Appendectomy. Thirty stones removed. The patient feels perfectly well, with the exception of occasional slight attacks of jaundice without pain or any other manifestations.

CASE 19. Miss C. M. F. March 21, 1918. Appendectomy. Release of adhesions about gall bladder. No stones. Gall bladder drained. In May, 1920, she was confined to bed for 2 weeks. Symptoms as before operation but much less severe. She was quite neurotic until married in August, 1920. Since then has gained 38 pounds and has had no symptoms.

CASE 20. Mrs. G. O. December 10, 1918. Appendectomy. Stones removed from gall bladder. Symptoms as before operation, but much less severe.

CASE 21. Mrs. C. H. T. May 5, 1919. Appendectomy. Marked ptosis of liver. Stones removed from gall bladder. The patient states that except for frequent attacks of distention she is perfectly well.

CASE 22. Mrs. J. A. B. March 10, 1919. Appendectomy. Stones removed from gall bladder. Gall-bladder wall friable; about 50 cubic centimeters of pus obtained. Recurrent attacks since operation, but much less severe and of shorter duration.

CASE 23. Mrs. J. C. M. March 3, 1919. Appendectomy and modified Gilliam suspension of uterus. Stones removed from gall bladder. A good deal of indigestion since operation.

CASE 24. Mrs. J. D. February 11, 1919. Appendectomy and modified Gilliam suspension. Forty stones removed from gall bladder and a large amount of putty-like material. Several attacks since May, 1921, but not so long nor so severe as before operation.

CASE 25. Mrs. G. F. M. December 21, 1920. Adhesions released about gall bladder; no stones. Gall bladder drained. She still has indigestion, but has been much improved by operation.

CASE 26. Mrs. A. S. October 18, 1919. Appendectomy. Typical gall-bladder symptoms for years. Fifty stones removed. Fell 1 week after return home and wound reopened, discharging freely for 2 weeks. Severe pain in region of gall bladder for several months. Doing well now. Does all her house work at present.

SUMMARY OF PATIENTS LIVING AND WELL AFTER DRAINAGE OF THE GALL BLADDER

In order that the reader may gain a clear idea of just how long the patients have remained well since operation, I have for convenience grouped them as follows:

	Acute	Chronic	Exploratory during other operations	Total
Those well 1 to 3 years after operation	22	20	0	42
Those well 3 to 5 years after operation	14	22	6	42
Those well 5 to 10 years after operation	14	25	7	46
Those well over 10 years after operation	15	20	3	38
Death from other causes; no return of gall-bladder symptoms (see table)	18	13	3	34
	83	100	19	202

1. Patients Living and Well, One to Three Years After Operation

CASE 1. Mrs. G. W. McC. February 6, 1919. Gastro-intestinal upsets. No jaundice. Perineal repair. Appendectomy. Right rectus incision. Gall bladder slightly adherent, tarry bile would not flow through trocar. Fifty small stones removed.

CASE 2. Miss E. McC. October 13, 1919. Gall bladder and appendix history. Right rectus incision. Appendix adherent. Removed. Six stones removed.

CASE 3. Mrs. S. E. D. April 8, 1919. The patient had given birth to a full-term baby 6 weeks before. Pain in gall-bladder region and right shoulder. Patient acutely ill. Gall bladder long and small, free from adhesions; some small stones removed.

CASE 4. Miss A. G. November 17, 1919. Jaundice at times. Appendectomy. Gall bladder thickened near its tip, felt almost like new-growth; wedge removed from fundus of gall bladder; 12 small stones removed.

CASE 5. Mrs. E. B. H. November 4, 1919. Appendectomy 10 or 12 years ago. Definite gall-bladder attacks. Pelvic examination reveals definite adenomyoma. Right rectus incision. Small stones and two large conglomerate masses; also some stones down in cystic duct.

CASE 6. Mrs. W. F. F. May 19, 1919. Cervical and perineal repair. Definite gall-bladder symptoms. Mid-line incision. Appendectomy. Modified Gilliam suspension. Right rectus incision. One conglomerate mass of 20 stones. Stones removed.

CASE 7. Mrs. F. H. March 10, 1920. Gall-bladder symptoms. Right rectus incision. Walls 3 millimeters thick. Stone in cystic duct, removed with difficulty.

CASE 8. Mrs. C. R. P. October 23, 1920. Gall-bladder symptoms. Gall bladder palpable and tender. Right rectus incision. Fat indurated. Abscess with 40 cubic centimeters of pus, rather grumous and sticky, just under peritoneum.

CASE 9. Mrs. A. December 6, 1920. Many gall-bladder attacks. Gridiron incision. Appendix adherent, free fluid. Appendectomy. Right rectus incision. Gall-bladder walls 3 to 5 millimeters thick and very friable. One hundred cubic centimeters of pus. Stones removed, one wedged in cystic duct.

CASE 10. Mr. F. H. K. May 13, 1919. Gridiron incision. Appendix thickened and adherent. Appendectomy. Right rectus incision. Stones removed; stone in cystic duct; to dislodge these it was necessary to slit gall bladder down to duct.

CASE 11. M. W. H. March 25, 1919. Indigestion. White blood cells 22,000. Temperature 101°. Gridiron incision. Free milky fluid. Appendix twice normal size. Removed. Right rectus incision. Gall bladder distended, yellowish green and mottled due to commencing gangrene. One stone in cystic duct.

CASE 12. Mrs. J. A. J. April 3, 1920. Appendix and gall-bladder symptoms. Appendectomy with difficulty. Few small gall stones and one 2 centimeters in diameter embedded in cystic duct.

CASE 13. Mrs. D. S. February 26, 1919. Appendix and gall-bladder symptoms. McBurney incision. Appendectomy. Right rectus incision. Gall bladder adherent, covered with lymph. Much pus present. Stone embedded in cystic duct.

CASE 14. Mr. W. E. W. October 29, 1919. Temperature 101°. White blood cells 21,000. Moderate abdominal distention. Gridiron incision. Atrophic appendix removed. Right rectus incision. Liver 4 inches below costal margin and gall bladder far in under the liver. Œdema of surrounding tissue. Four or five yellowish-green patches of gangrene on gall-bladder wall. One irregular stone removed. Cystic duct thickened, but contained no stones.

CASE 15. Mr. C. P. March 25, 1920. Acute cholecystitis. White blood cells 21,600. Right rectus incision. Two hundred cubic centimeters of turbid fluid. Gall bladder friable. Much pus. Stones removed.

CASE 16. Mr. J. K. June 7, 1920. Large gall bladder. Omentum adherent. Suspensory ligament cut. Gall bladder liberated. Many small stones; one 1.5 centimeters in diameter; several in cystic duct.

CASE 17. Mrs. J. A. June 14, 1920. White blood cells 9,000. Gall-bladder symptoms. Right rectus incision. Liver enlarged, peritoneum thickened. Œdematous tissue about gall bladder. Gall-bladder wall 3 to 4 millimeters thick. Greenish area at one point where gall bladder was perforated. One stone 2 centimeters long removed.

CASE 18. Mrs. H. A. G. January 18, 1921. Gall-bladder attacks for 5 years. Gridiron incision. Appendectomy. Right rectus incision. Gall bladder small and normal. Sixty dark grayish-black stones removed.

CASE 19. M. T. March 21, 1921. Diabetes. Sore throat (hæmolytic streptococcus). Umbilical hernia. Myomata uteri. Mid-line incision. Hysteromyomectomy and appendectomy. Repair of umbilical hernia. Right rectus incision. Forty stones removed.

CASE 20. Mrs. E. S. March 10, 1921. Gall-bladder and appendix symptoms. Gridiron incision. Retrocæcal appendix, adherent and enlarged. Appendectomy. Right rectus incision. Sixty stones; putty-like material. Gall-bladder walls thick.

CASE 21. Mrs. W. L. October 13, 1920. Jaundice. Gall-bladder symptoms. Gridiron incision. Appendectomy. Right rectus incision. Stones removed.

CASE 22. Mrs. A. R. M. November 6, 1920. Typhoid fever several years before. Cardiorenal history. Signs of obstruction. Gall-bladder symptoms. Acute attack at present. Right rectus incision. (Local anæsthesia.) Four hundred cubic centimeters of pus. No stones.

CASE 23. Mrs. J. H. September 15, 1920. Gall-bladder symptoms. Shadow in gall-bladder region on X-ray plate. Gridiron incision. Appendix normal, removed. Right rectus incision. Stone surrounded by putty-like material. Conglomerate stone down in cystic duct.

CASE 24. Mrs. C. H. C. March 16, 1920. Gall-bladder and appendix symptoms for years. Gridiron incision. Appendectomy. Right rectus incision. Forty-two triangular-shaped gall stones.

CASE 25. Mrs. H. R. April 1, 1920. Gall-bladder and appendix symptoms. Gridiron incision. Appendix injected. Appendectomy. Right rectus incision. Eighty stones removed. None in ducts.

CASE 26. Mrs. G. K. July 11, 1919. Ill 1 month with gall-bladder pain. Appendix normal. Cæcum adherent. Adhesions released. Appendectomy. Right rectus incision. Gall bladder constricted by adhesions. Gall bladder adherent to omentum and duodenum. No stones.

CASE 27. Mr. T. P. February 1, 1919. Gastro-intestinal symptoms. Stones diagnosed from X-ray plate. Gridiron incision. Appendix adherent.

Appendectomy. Right rectus incision. Liver smaller than normal. Gall bladder full of stones lying 6 inches beneath surface of liver and transversely. A most difficult gall bladder to expose. Several hundred shot-like stones removed. Some down in cystic duct.

CASE 28. Miss N. R. June 21, 1920. Appendix and gall-bladder symptoms. Gridiron incision. Appendectomy. Right rectus incision. Gall bladder small, thick-walled; milky tenacious fluid with mulberry shaped stones. One in cystic duct had to be broken up before removal.

CASE 29. Mrs. J. B. E. March 31, 1919. The patient had given birth to a full-term child 2 weeks before. Several acute gall-bladder attacks without fever. Right rectus incision. Yellowish serous fluid in peritoneal cavity. Acute pancreatitis. Gall bladder of normal size, not adherent. Forty stones removed. A few stones were found in cystic duct.

CASE 30. Mrs. J. E. N. October 6, 1919. No jaundice. Indigestion. Temperature normal. White blood cells 15,000. Appendix contained concretions. Appendectomy. Much œdema in tissues about gall bladder and duodenum. Fifty triangular stones removed.

CASE 31. Mrs. O. S. January 2, 1919. History of gall-bladder attacks with jaundice. Gridiron incision. Tip of appendix adherent and thickened. Right rectus incision. Stones removed.

CASE 32. Mrs. G. R. January 4, 1919. Several gall-bladder attacks. Gridiron incision. Appendix enlarged. Appendectomy. Right rectus incision. Gall bladder 7 inches long, adherent to omentum. Eight stones removed.

CASE 33. Mrs. C. B. December 6, 1920. Gall-bladder and appendix symptoms. McBurney incision. Appendix adherent. Very friable; broke off at base. Right rectus incision. Ten stones removed, 4 in cystic duct.

CASE 34. Mrs. M. C. June, 1920. Jaundice. Right rectus incision. Gall bladder not enlarged. Twenty cubic centimeters of gelatinous, tarry material with minute stones. Stone about 3 centimeters in diameter down at cystic duct.

CASE 35. Mrs. H. L. May 19, 1919. Gall-bladder attacks with jaundice. Gridiron incision. Appendix thickened and cæcum adherent. Right rectus incision. Pancreas thickened; twice the normal size and nodular. One conglomerate stone in gall bladder. Gall bladder not thickened.

CASE 36. Mr. J. W. H. October 16, 1920. Sudden and marked jaundice. Right rectus incision. Markedly adherent. Gall bladder small and contracted. Cystic duct thickened. No stones made out, but inflammatory condition obstructing the common duct.

CASE 37. Mrs. F. McL. March 31, 1920. A very stout woman. Definite gall-bladder history. Gridiron incision. Appendix enlarged and adherent. Appendectomy. Right rectus incision. One stone removed.

CASE 38. Mrs. J. B. March 29, 1920. No jaundice. Rheumatic spine. Gridiron incision. Appendix normal. Appendectomy. Right rectus incision. Gall bladder packed with stones. Stones removed.

CASE 39. Mr. T. L. R. December 13, 1920. Gall-bladder symptoms at present. Similar attack 30 years ago. Gall bladder large and contained black stones resembling cinders. Stones removed from gall bladder and cystic duct.

CASE 40. Mrs. O. April 7, 1919. Jaundice for a few days and discomfort in gall-bladder region. Right rectus incision. Gall bladder distended but free from adhesions. Fifty stones removed. Many down in cystic duct.

CASE 41. Miss D. M. H. February 2, 1920. Several gall-stone attacks and slight jaundice at present. Very stout woman. Right rectus incision. One stone removed.

CASE 42. Mrs. J. G. K. June 1, 1920. Mid-line incision. Appendectomy. Modified Gilliam suspension. Right rectus incision. One stone removed.

2. Patients Living and Well, Three to Five Years After Operation

CASE 1. Mrs. J. W. D. April 8, 1918. Appendix and gall-bladder history. McBurney incision. Appendix adherent. Appendectomy. Right rectus incision. Six large stones and many small ones. Gall bladder adherent.

CASE 2. Mrs. W. Z. February 13, 1918. Gall-bladder symptoms since labor in August, 1916. Median incision. Modified Gilliam suspension. Appendectomy. Right rectus incision. Forty stones removed.

CASE 3. Mrs. M. G. February 8, 1917. History of jaundice. Soreness at right costal margin. Some tenderness over McBurney's point. McBurney incision. Appendix tied down in middle portion. Right rectus incision. One conglomerate stone made up of numerous small ones. Removed.

CASE 4. Mrs. J. H. P. July 12, 1918. Gall-bladder symptoms with jaundice. Mid-line incision. Myomectomy. Appendix adherent—removed. Right rectus incision. Gall bladder enlarged; contained bile and stones. Stones removed.

CASE 5. Mrs. F. W. P. February 22, 1918. Several gall-stone attacks, never jaundiced. Repair of relaxed vaginal outlet. Gridiron incision. Appendectomy. Right rectus incision. Three stones removed.

CASE 6. Miss A. L. May, 1918. She had had gall-bladder symptoms for 2 years. Very fat. Appendix enlarged and distended. Appendectomy. Right rectus incision. Six stones, one in cystic duct crushed during attempts to remove it.

CASE 7. Mrs. B. G. March 27, 1918. Appendix normal. Appendectomy. Gall bladder contained one irregular stone, 1.5 centimeters long, and some smaller ones. Gall bladder drained.

CASE 8. Mrs. N. T. W. June, 1917. Pain along right costal margin and marked jaundice. White

blood cells 19,000. Gridiron incision. Appendix small and tied up under the liver. Right rectus incision. Tip of appendix removed from under surface of liver. Gall bladder very adherent. Golden yellow mucoid material but no definite stones.

CASE 9. Miss I. C. October 22, 1916. Acute gall-bladder pain. Ruptured duodenal ulcer suggested. Jaundice a little later. Right rectus incision. Gall bladder and omentum adherent. Stones removed from gall bladder; one blocking cystic duct. Pancreas thickened, with sharp edge. Duodenum not opened.

CASE 10. Mrs. J. O. B. January 9, 1917. Gridiron incision. Omentum adherent. Appendectomy. Right rectus incision. Many triangular stones. Gall-bladder walls whitish yellow. Small calcareous body at junction of cystic and common duct which could not be loosened.

CASE 11. Mrs. H. B. M. April 7, 1917. Mid-line incision. Uterus one and a half times the normal size and very firm. Supravaginal hysterectomy. Bilateral salpingo-oophorectomy. Appendix, retrocæcal and adherent. Appendectomy. Right rectus incision. Gall bladder small and free from adhesions. Stone 8 millimeters in diameter, acting as a ball-valve.

CASE 12. Mrs. M. K. March 15, 1917. Pain down right side, more marked over gall bladder. Gridiron incision. Appendix twice normal size. No adhesions. Right rectus incision. Gall bladder free from adhesions. Several hundred stones, one densely adherent in cystic duct.

CASE 13. Mrs. T. F. D. October 31, 1917. Gall-bladder symptoms for past 3 or 4 years. Gridiron incision. Omentum adherent. Appendectomy. Right rectus incision. Adhesions about cystic duct, only. Cystic duct filled with stones and markedly thickened. Upper part of gall bladder removed.

CASE 14. Mrs. G. F. June 21, 1918. Pain over appendix and gall bladder. No signs of pregnancy. Dilatation and curettage. Repair of relaxed vaginal outlet. Gridiron incision. Appendectomy. Right rectus incision. Gall bladder filled with stones. Stones removed, one from cystic duct.

CASE 15. Mrs. E. P. April 22, 1918. History of gall-bladder lesion. Right rectus incision. Appendix full of hard concretions; adherent and lay up in region of liver. Gall bladder strawberry type but contained no stones. Lymph gland 1 centimeter long on either side of common duct, which probably accounted for intermittent jaundice.

CASE 16. Mrs. H. G. D. September 26, 1917. Gall-bladder symptoms. Excruciating pain in past 24 hours. Gridiron incision. Appendix one and a half times normal size and adherent. Appendectomy. Right rectus incision. Sixty stones removed.

CASE 17. Mr. J. H. October 18, 1918. Several gall-bladder attacks. Right rectus incision. Gall bladder smooth, free from adhesions, but very tense. Five stones removed.

CASE 18. Mrs. V. M. March 27, 1918. Definite gall-bladder history. Jaundice several weeks ago. Appendix operation 2 years ago. Postoperative hernia. Repair of hernia. Right rectus incision. Gall bladder small and adherent. No stones.

CASE 19. Miss H. McM. October 16, 1917. Appendectomy several years ago. Frequent acute gall-bladder attacks. Right rectus incision. Gall bladder adherent to duodenum, cæcum, and ascending colon. Gall bladder strawberry type. Stones removed.

CASE 20. Mrs. J. G. April 12, 1918. Gall-bladder symptoms for 13 years. Gridiron incision. Appendectomy. Right rectus incision. Dense gall-bladder adhesions released. Many stones removed.

CASE 21. Miss H. R. July 16, 1918. Typical gall bladder and appendix history. Gridiron incision. Velvety adhesions about appendix. Appendix removed. Right rectus incision. Stones removed.

CASE 22. Mrs. G. B. W. October 26, 1916. Gall-bladder symptoms for 18 months. Occasional jaundice. Gridiron incision. Appendectomy. Right rectus incision. Stones removed.

CASE 23. Mrs. G. K. March 15, 1918. Definite gall-bladder history. Gridiron incision. Appendectomy. Right rectus incision. One large stone removed.

CASE 24. Mrs. J. F. McC. June 27, 1918. Several mild gall-bladder attacks with jaundice. Gridiron incision. Appendectomy. Right rectus incision. Gall bladder adherent. Stones removed from gall bladder and cystic duct.

CASE 25. Mrs. H. January 16, 1918. Appendectomy several years ago. Indefinite gall-bladder history. X-ray plate showed 13 small stones. Right rectus incision. Gall bladder adherent. Thirteen stones removed.

CASE 26. Mrs. W. F. December 6, 1916. Gall-bladder symptoms. Gall bladder fills greater part of right abdomen. Right rectus incision. Tremendously long gall bladder. Stood up 6 inches from abdominal wall. Three hundred cubic centimeters of grumous brownish material, containing cholesterin crystals. Stone in cystic duct. Gall-bladder wall thickened and indurated. Excess of gall-bladder wall removed.

CASE 27. Mrs. M. December 10, 1918. Consultant felt there was an appendix and also a gall-bladder lesion. Repair of relaxed vaginal outlet. Median incision. Appendix removed. Modified Gilliam suspension of uterus. Right rectus incision. Gall bladder adherent.

CASE 28. Mrs. V. D. H. October 1917. No typhoid. Several gall-bladder attacks with jaundice. Right rectus incision. No adhesions. Stones removed.

CASE 29. Dr. A. C. H. October 7, 1917. Appendectomy 1 year ago. Symptoms not relieved. Typical gall-bladder attacks. Right rectus incision. Stones removed. Some in cystic duct. Gall-bladder wall very friable and markedly indurated. Since this tabulation was made patient has had several digestive attacks.

CASE 30. Dr. C. G. July 3, 1917. Appendix and gall-bladder history. Gridiron incision. Adhesions. Appendectomy. Right rectus incision. Gall bladder adherent. Stones removed.

CASE 31. Mr. F. P. B. July 22, 1918. Typical gall-bladder symptoms. Right rectus incision. Stones removed. Appendectomy.

CASE 32. Mrs. L. H. February 16, 1918. Gall-bladder and appendix history. Gridiron incision. Appendix injected. Removed. Right rectus incision. Gall bladder adherent. Stones removed.

CASE 33. Mrs. J. E. G. November 7, 1917. Appendix and gall-bladder symptoms. Gridiron incision. Appendectomy. Right rectus incision. Gall bladder adherent. Walls thickened and indurated. Stones and part of gall bladder removed.

CASE 34. Mrs. A. N. March 27, 1918. Gall-bladder symptoms. Gridiron incision. Appendectomy. Right rectus incision. Gall bladder adherent, friable and œdematous. Stones removed.

CASE 35. Mrs. J. M. April 7, 1917. Marked relaxed vaginal outlet. History of gall stones. Right rectus incision. Appendectomy. Stones removed. Repair of relaxed vaginal outlet.

CASE 36. Miss E. L. June 18, 1917. History of mitral disease following rheumatism. Tonsils burned out. Acute gall-bladder symptoms at present time. Gridiron incision. Appendix removed. Right rectus incision. Gall bladder filled with putty-like material.

CASE 37. Mrs. A. D. C. February 20, 1918. Gall-bladder history. Gridiron incision. Appendix adherent, removed. Right rectus incision. Gall-bladder adherent. Stones removed. Several in cystic duct.

CASE 38. Mrs. L. H. January 10, 1918. Gall-bladder symptoms. Right rectus incision. Gall bladder adherent. Walls thickened and indurated. Stones removed.

CASE 39. Mrs. M. M. W. November 22, 1917. Ovarian cyst with twisted pedicle. Temperature 101°. White blood cells 18,000. Median incision. Left ovarian cyst removed. Right rectus incision. Stones removed.

CASE 40. Mrs. B. S. March 3, 1917. Gall-bladder symptoms for 8 years. Right rectus incision. Gall bladder adherent. Adhesions easily liberated. Quantity of grayish fluid. Stones removed.

CASE 41. Mrs. H. G. C. July 25, 1918. Left ovarian cyst. Median incision. Ruptured multilocular ovarian cyst removed. Appendix removed. Right rectus incision. Stones removed. Small amount of pus in gall bladder.

CASE 42. Mrs. W. C. B. March, 1918. Typhoid six years ago. Jaundiced at present and gall-bladder symptoms. Gall-bladder adhesions. Drained No stones.

3. Patients Living and Well, Five to Ten Years After Operation

CASE 1. Mrs. I. B. June 19, 1916. Gall-bladder and appendix history. Myomata uteri. Gridiron incision. Appendix removed. Right rectus incision. Gall stones removed.

CASE 2. Mrs. T. R. H. May 2, 1914. Definite symptoms. Gall bladder palpable, quite tender, extends down to umbilicus. Right rectus incision. Gall bladder adherent. Large amount of pus. Stones removed.

CASE 3. Mrs. F. A. September 10, 1914. Pelvic operation by Dr. Kelly 18 years ago. Gall-bladder symptoms for past year. Right rectus incision. Three hundred cubic centimeters of pus. Stones removed. She is now 70 years old, has an arthritic lesion of the right knee and ankle.

CASE 4. Mrs. M. C. March 15, 1913. Gall-bladder symptoms. Right rectus incision. Appendectomy. Gall bladder large and thick-walled. Stones removed.

CASE 5. Mrs. B. O. October 23, 1912. Gall-bladder symptoms for 6 years. Right rectus incision. Gall-bladder wall dense and friable. Stones removed.

CASE 6. Mrs. E. P. March 17, 1913. Gall-bladder symptoms. Mid-line incision. Modified Gilliam suspension of uterus. Appendectomy. Right rectus incision. Gall bladder adherent. One stone removed.

CASE 7. Mrs. C. M. February 27, 1915. Definite gall-bladder history. Right rectus incision. Gangrenous patches visible over wall of gall bladder. Walls friable and very thick.

CASE 8. Mrs. F. H. February 1915. Median incision. Hysteromyomectomy. Appendectomy. Gall stones not suspected before operation. Right rectus incison. Stones removed.

CASE 9. Mrs. E. S. November 9, 1912. Typical symptoms with jaundice. Right rectus incision. Gall bladder adherent. Large stone in cystic duct, removed with difficulty.

CASE 10. Mrs. C. L. February 29, 1912. Gall-bladder symptoms for 5 years. Right rectus incision. Appendix removed. Gall bladder adherent. Considerable pus. Stones removed.

CASE 11. Mrs. C. S. S. June 15, 1912. Frequent attacks with jaundice. Right rectus incision. Appendix adherent. Removed. Gall bladder adherent. Stones removed from gall bladder and cystic duct.

CASE 12. Mrs. J. P. G. March 13, 1916. Frequent typical gall-bladder attacks. Complete prolapsus of uterus. Amputation of cervix. Vaginal fixation of uterus. Repair of relaxed vaginal outlet. Right rectus incision. Many stones removed. One from cystic duct.

CASE 13. Mrs. C. H. A. April 21, 1913. Typical attacks in past year. Median incision. Uterus and adnexa normal. Atrophic appendix removed. Right rectus incision. Gall bladder adherent. Fifty stones removed. Several stones encapsulated outside of gall bladder.

CASE 14. Mrs. F. M. M. March 26, 1913. Typical symptoms with jaundice. Uterus in retroposition. Median incision. Modified Gilliam sus-

pension of uterus. Appendectomy. Right rectus incision. Gall stones removed.

CASE 15. Mr. O. M. November 2, 1914. Very fat man. Acute attack at present. Temperature 101°. White blood cells 15,000. Right rectus incision. Much pus and many small stones removed.

CASE 16. Mr. H. C. S. October 19, 1916. Typhoid fever 20 years ago. Gall-bladder attacks for past 6 years. Loss of 45 pounds in past 3 years. White blood cells 13,000. Right rectus incision. Gall bladder adherent. Two hundred stones. Gall bladder lay transversely; cystic duct coming off at right angles. Many stones in cystic duct.

CASE 17. Mrs. J. B. W. May 27, 1916. Gall-bladder symptoms for 18 years. Right rectus incision. Gall bladder distended. Many stones removed.

CASE 18. Mrs. W. L. November 12, 1915. Acute cholecystitis. Onset 48 hours before. Temperature 104 . Right rectus incision. Gall bladder adherent. Gangrenous area. Stones removed.

CASE 19. Mrs. P. July 3, 1914. Gall-bladder lesion not suspected before operation. Uterus enlarged and adherent. Adnexa glued down in pelvis Mid-line incision. Hysterectomy. Bilateral salpingo-oophorectomy. Appendectomy. Right rectus incision. Stones removed.

CASE 20. Mrs. H. A. June 21, 1913. Definite gall-bladder history. Stones have been found in stools after attacks. Right rectus incision. Gall bladder distended, walls friable. One hundred and fifty cubic centimeters of pus. Many stones removed, some from cystic duct.

CASE 21. Mrs. T. C. May 17, 1913. Typical gall-bladder symptoms. Right rectus incision. Appendix small and adherent. Appendectomy. Gall bladder adherent. Stones removed.

CASE 22. Mrs. J. E. B. May 5, 1913. Typical gall-bladder symptoms. Right rectus incision. Appendix atrophic. Appendectomy. Gall bladder quite adherent and full of stones.

CASE 23. Mrs. H. D. M. November 5, 1912. Typical gall-bladder symptoms, with jaundice and recent loss of weight. Right rectus incision. Gall bladder adherent, distended; 20 stones removed, about 75 cubic centimeters of pus present.

CASE 24. Mrs. B. E. B. June 4, 1913. Curettage for irregular bleeding. Definite history of appendicitis and gall-bladder lesion. There has been jaundice during many attacks. Right rectus incision. Appendectomy, many stones removed from the gall bladder.

CASE 25. Mrs. W. L. F. May 23, 1912. Gall-bladder symptoms for past 10 years. Right rectus incision. Appendix adherent, appendectomy. Gall bladder adherent; many stones and a large amount of putty-like material removed.

CASE 26. Mrs. L. G. November 1912. Typical symptoms for many months. Gall bladder easily palpated. Right rectus incision. Gall-bladder wall thickened and adherent; many stones removed.

CASE 27. Mrs. F. W. V. February 7, 1913. Typical symptoms for 9 months. Right rectus incision. Seven stones removed.

CASE 28. Mrs. A. K. September 16, 1916. Definite gall-bladder symptoms. X-ray plates negative. Right rectus incision. Gall-bladder wall thickened. Many stones removed. Cystic duct thickened.

CASE 29. Mrs. J. E. H. May 25, 1916. Very stout woman. Typical gall-bladder symptoms. Right rectus incision. Gall bladder adherent. Several stones removed; one from cystic duct. Small amount of pus present.

CASE 30. Mrs. H. S. H. March 18, 1915. Preoperative diagnosis not made. Operation undertaken for removal of fibroids. Mid-line incision, hysteromyomectomy, left salpingo-oophorectomy and appendectomy. Right rectus incision; 4 stones removed.

CASE 31. Mrs. G. A. July 6, 1916. Definite gall-bladder and appendix history. Gridiron incision. Appendix injected and adherent. Appendectomy. Right rectus incision, many stones removed.

CASE 32. Mrs. L. M. October 14, 1914. Preoperative diagnosis of appendix or gall-bladder lesion. Repair of relaxed vaginal outlet. Hæmorrhoidectomy. Right rectus incision. Retrocæcal appendix. Appendectomy. Gall stones removed.

CASE 33. Mrs. J. C. June 15, 1912. Gall-bladder symptoms for the past year. Right rectus incision. Gall bladder adherent. One large stone removed.

CASE 34. Mrs. G. A. A. December 7, 1914. Typical gall-bladder attacks. Right rectus incision. Twenty stones removed from gall bladder; 1 stone encysted in cystic duct. Small amount of pus present.

CASE 35. Dr. J. H. P. October 5, 1916. Onset 6 days ago with symptoms suggesting intestinal obstruction; chills. White blood cells 14,000. Preoperative diagnosis; empyema of gall bladder. Right rectus incision. Gall bladder adherent, walls thickened, anterior wall gangrenous. One hundred cubic centimeters of pus present and about 20 stones.

CASE 36. Mrs. L. McP. September 14, 1914. Acute symptoms in past 24 hours. Temperature 101°. White blood cells 16,000. Right rectus incision. Gall-bladder walls gangrenous, ruptured at one point. Large amount of pus removed; one small stone found in cystic duct.

CASE 37. Mrs. H. V. January 16, 1913. Gastroenterostomy several years ago, release of adhesions after this operation, resection of ascending and portion of transverse colon with lateral anastomosis of ileum to transverse colon. (These operations by other surgeons some years before present admission.) Right rectus incision. Gall bladder densely adherent and thick walled. No stones found.

CASE 38. Mrs. O. F. January 4, 1915. Typhoid fever 30 years ago. Frequent gall-bladder attacks since then, occasionally accompanied by jaundice.

Right rectus incision. Gall bladder adherent; 30 stones removed.

CASE 39. Mrs. M. E. B. October 20, 1915. Appendix and gall-bladder symptoms. Gridiron incision, appendectomy. Right rectus incision. Gall-bladder wall thickened, with definite gangrenous areas. One hundred cubic centimeters of pus. Stone measuring 1 by 3 inches removed—the largest I have ever seen.

CASE 40. Miss L. E. September 22, 1913. Typical gall-bladder symptoms, with acute exacerbation at present. Right rectus incision. One hundred stones removed and large amount of pus.

CASE 41. Mrs. M. N. November 23, 1913. Typical gall-bladder symptoms, with exacerbation at present. Temperature 101°. White blood cells 16,000. Right rectus incision. Large amount of pus present. Three stones removed, one from cystic duct.

CASE 42. Mrs. C. H. L. February 15, 1916. Definite history of diabetes, which is completely controlled by diet. Operation undertaken for gynecological condition. Gall-bladder lesion not diagnosed before operation. Perineal operation, trachelorrhaphy; anterior and posterior colporrhaphy. Mid-line incision. Hysterectomy and appendectomy. Right rectus incision; three small stones removed.

CASE 43. Mrs. C. F. L. November 13, 1916. The patient has a definite infectious arthritis. Tonsillectomy; and numerous teeth have been extracted as possible foci of infection. Condition not relieved. Operation for repair of cervix and repair of relaxed vaginal outlet. Mid-line incision. Modified Gilliam suspension of the uterus. Appendix adherent; appendectomy. Right rectus incision. Six stones removed. The arthritic condition completely disappeared within a few weeks after operation.

CASE 44. Mrs. D. C. D. November 19, 1914. Mid-line incision for huge multilocular ovarian cyst. Right rectus incision. Gall bladder adherent. Stone removed from cystic duct.

CASE 45. Mrs. R. H. February 19, 1913. Typical gall-bladder symptoms. Marked laceration of the cervix, relaxation of the vaginal outlet and retroposition of the uterus. Amputation of cervix and repair of relaxed vaginal outlet. Mid-line incision. Modified Gilliam suspension of the uterus. Appendectomy. Right rectus incision. Many stones removed from gall bladder.

CASE 46. Mrs. J. E. C. February 4, 1915. Exploratory operation. Gall bladder found adherent, full of stones; much pus present. Stone removed from cystic duct.

4. Patients Living and Well, Ten or More Years After Operation

CASE 1. Mrs. J. H. H. June 9, 1911. Gall-bladder symptoms for 15 years. Typhoid fever 18 years ago. Mid-line incision. Modified Gilliam suspension and appendectomy. Right rectus incision. Gall bladder filled with viscid tarry bile. No stones.

CASE 2. Mrs. A. E. February 2, 1909. Sudden gall-bladder attack several days ago. Not relieved by morphine. Right rectus incision. Gall bladder much distended and adherent low down; forty cubic centimeters of pus. Many stones removed.

CASE 3. Mr. E. D. L. June 9, 1907. Gastro-intestinal symptoms for 40 years. Jaundice accompanies these attacks. McBurney incision. Appendectomy. Right rectus incision. Gall bladder adherent, wall thickened. Stones removed.

CASE 4. Miss S. F. J. November 26, 1910. Vague gastro-intestinal symptoms suggesting appendicitis or gall-bladder lesion. Right rectus incision. Normal appendix removed. Gall bladder adherent. Stones removed.

CASE 5. Mrs. C. E. H. May 19, 1909. Marked pain and tenderness along right costal margin. Right rectus incision. Stones removed from gall bladder.

CASE 6. Mrs. H. R. January, 1909. Severe gall-bladder attack 15 years ago. Frequent mild attacks since then. Appendix symptoms also. McBurney incision. Normal appendix removed. Right rectus incision. Gall bladder had evidently ruptured during attack 15 years before. Several stones embedded in adhesions outside the gall bladder removed. Adhesions released.

CASE 7. Miss C. S. June 3, 1910. Typhoid fever 30 years ago. Frequent gall-bladder attacks. Right rectus incision. Appendectomy. Gall-bladder wall thickened and friable. Stones removed.

CASE 8. Mrs. A. January 7, 1907. Frequent gall-bladder and appendix attacks. Acute symptoms for past 3 days. White blood cells 15,400. McBurney incision. Appendectomy. Right rectus incision. Gall-bladder wall thickened. Many putty-like stones. Redundant portion of gall-bladder wall was encrusted with calcareous plaques. This area of the wall was excised.

CASE 9. Mrs. A. J. D. October 29, 1910. Gall-bladder history. Some symptoms due to a relaxed vaginal outlet. Repair of relaxed vaginal outlet. Dilatation and curettage. Right rectus incision. Appendectomy and removal of gall stones.

CASE 10. Mrs. A. C. November 24, 1908. Acute gall-bladder symptoms. White blood cells 23,000. Temperature 103°. Right rectus incision. Some pus in gall bladder. Stones removed. Large stone in cystic duct; removed with difficulty.

CASE 11. Mr. J. M. G. October 1, 1910. Indefinite gall-bladder attacks for 14 years. Suggestive of a duodenal ulcer? Right rectus incision. Gall bladder adherent. Much pus. Stones removed.

CASE 12. Mrs. S. March 3, 1907. Acute symptoms with excruciating pain in past 9 hours. White blood cells 13,000. Right rectus incision. Appendix and gall stones removed.

CASE 13. Rev. A. May 7, 1910. Numerous gall-bladder attacks with clay-colored stools and jaundice. Right rectus incision. Stones removed.

CASE 14. Mrs. B. F. B. November 27, 1907. Appendectomy 5 years ago, by another surgeon.

Excruciating gall-bladder pain with jaundice for past 2 days. Right rectus incision. Gall bladder adherent. Stones removed. Cystic duct thickened and indurated.

CASE 15. Mrs. E. W. May 14, 1907. Several severe gall-bladder attacks. Appendectomy and removal of gall stones.

CASE 16. Mr. T. November 18, 1909. Acute gall-bladder symptoms for 2 days. Temperature 101°. Gall-bladder palpable, extends 4 centimeters below costal margin. Right rectus incision. Gall-bladder quite distended. Several irregular greenish spots on wall just ready to rupture. One hundred cubic centimeters of pus. Stones removed.

CASE 17. Mrs. F. E. B. January 14, 1910. Gall-bladder history. Right rectus incision. Appendectomy. Gall bladder tremendously distended, reaches to umbilicus. Two hundred stones removed.

CASE 18. Mrs. S. March 27, 1910. Definite acute attack. Suggests acute appendicitis or cholecystitis. McBurney incision. Normal appendix removed. Right rectus incision. Gall bladder distended. Stones removed.

CASE 19. Mrs. C. W. June 21, 1907. Pelvic operation 2 years ago. Whitehead operation for hæmorrhoids and prolapsus. Suspension of uterus and release of adhesions. Typical gall-bladder attack at present time. Right rectus incision. Appendectomy. Gall bladder distended. No stones. Opened and drained.

CASE 20. Mrs. K. K. October 17, 1911. Definite gall-bladder attack 2 years ago. Several attacks since then associated with jaundice and fever. Right rectus incision. Gall-bladder wall thin as parchment. Stones removed from gall bladder and cystic duct.

CASE 21. Mrs. A. January 2, 1912. Typical intermittent attacks for 10 years associated with jaundice. Right rectus incision. Gall-bladder wall friable and thickened. No stones. Appendix removed.

CASE 22. Miss M. A. H. April 3, 1911. Typical gall-bladder symptoms. Right rectus incision. Appendix adherent; removed. Gall-bladder adherent to stomach and duodenum. Stones removed. A considerable amount of inspissated bile.

CASE 23. Mrs. W. M. June 17, 1901. Typical attacks for past 8 years associated with jaundice and clay-colored stools. Right rectus incision. Gall-bladder walls thickened. Gall-bladder embedded in adhesions. Stones removed.

CASE 24. Mrs. T. August 15, 1908. Aged 60 years. She has been having gall-bladder attacks for 25 years. Acute attack at present time. Globular tender mass extends from costal margin to umbilicus. Right rectus incision. Empyema of gall bladder, which is quite adherent to transverse colon, stomach, and abdominal wall. Wall of gall bladder 1 centimeter thick. Large amount of pus. Several drams of sand-like calcareous material. Two-thirds of gall-bladder wall removed.

CASE 25. Mrs. M. W. January 5, 1907. Vague gastro-intestinal symptoms. Mid-line incision. Pelvic organs normal. Right rectus incision. Gall bladder quite adherent but contained no stones.

CASE 26. Mrs. A. M. May 1, 1910. Frequent typical attacks with jaundice. Right rectus incision. Gall-bladder wall thickened. Stones removed. One stone in common duct.

CASE 27. Mrs. C. S. December 19, 1910. Now in fourth week of typhoid fever. Sudden gall-bladder symptoms. Temperature 102.5°. Round, tender, globular mass below right costal margin. Right rectus incision. (Gas anæsthesia.) One hundred cubic centimeters of pus. Gall-bladder walls were adherent, thickened, and friable. Stone was removed.

CASE 28. Miss J. C. October 5, 1906. Typical attacks for 2 years. Right rectus incision. Gall-bladder adherent to duodenum. Stones removed.

CASE 29. Miss B. L. May 13, 1908. Typical attacks for 10 years associated with jaundice. Right rectus incision. Gall bladder adherent. Stones removed.

CASE 30. Mrs. L. I. H. June 27, 1908. Several attacks associated with jaundice. Present attack of 48 hours' duration. Right rectus incision. Gall bladder adherent to omentum. Contains large amount of mucus and pus. Walls injected. No stones.

CASE 31. Mrs. C. P. K. October 6, 1904. Typical symptoms. Right rectus incision. Gall bladder 8 inches long. Wall thickened and friable. Much pus. Stones removed.

CASE 32. Mr. J. January 6, 1910. Typical symptoms. McBurney incision. Appendix injected, removed. Right rectus incision. Gall-bladder wall gangrenous and had ruptured at one point. Much pus. Stones removed.

CASE 33. Mr. J. W. July 5, 1910. Frequent attacks. Acute attack at present time. Right rectus incision. Gall bladder ruptured. Five hundred cubic centimeters of dark bile in peritoneal cavity. Gall bladder extends down to umbilicus. Liver margin covered by greenish yellow exudate. Twenty-one stones removed. Drained through right rectus and McBurney incisions.

CASE 34. Mrs. O. M. B. January 9, 1909. Acute gall-bladder attack. Right rectus incision. Gall bladder enlarged, indurated and œdematous. Much pus. Stones removed.

CASE 35. Mr. A. W. June 30, 1904. Typical attacks. Right rectus incision. Numerous adhesions, but no stones. Appendix removed.

CASE 36. Mrs. W. February 24, 1904. Has lost 40 pounds in 4 months. Malignancy of body of uterus suspected. Mid-line incision. Pelvic organs normal. Right rectus incision. Gall-bladder walls thickened and indurated. Stone wedged in cystic duct. Stone removed. Cystic duct had to be incised; cystic duct closed with catgut.

CASE 37. Mrs. J. C. April 9, 1902. Frequent typical attacks with jaundice. Right rectus in-

cision. Gall bladder distended and adherent. Stones removed.

CASE 38. Mrs. R. P. L. May 31, 1911. History of typhoid fever. Several typical gall-stone attacks. Acute attack at present time. Two months pregnant. Right rectus incision. Appendectomy. Stones removed. Pregnancy went to term. Child living and well.

SUMMARY OF CASES OF PATIENTS WHO DIED LATER OF SOME OTHER DISEASE—NO RETURN OF GALL-BLADDER SYMPTOMS

CASE 1. Mrs. F. M. October 30, 1917. Many gall-bladder attacks. Gall bladder thickened; walls friable. Many stones removed. Gall bladder drained. The patient did very well for several years. Her physician states that carcinoma of the liver developed, of which she died.

CASE 2. Mrs. H. H. October 14, 1920. Definite gall-bladder history. Stones removed and gall bladder drained. Did well for 10 years. Her physician states that signs of malignancy then developed and the patient soon died.

CASE 3. Rev. A. November 23, 1904. Stones removed and gall bladder drained. Died 1 year later of carcinoma of the liver.

CASE 4. Mrs. J. R. January 4, 1915. Typical symptoms. Stones removed and gall bladder drained. Noted at operation that the common and cystic ducts were indurated and that the pancreas was twice the normal size and quite indurated, suggesting malignancy. The patient recovered but died of carcinoma of the pancreas a year later.

CASE 5. Mrs. W. S. June 7, 1916. Typical gall-bladder symptoms. Active pulmonary tuberculosis at the time of operation. Operation performed under local anæsthesia. Pancreas three times the normal size and indurated. Small nodule in liver. Gall bladder drained. The patient did well. Drainage sinus closed. Death within a year of carcinoma of the pancreas.

CASE 6. Mrs. C. H. L. February 26, 1919. Definite gall-bladder history. Mid-line incision. Chocolate-colored fluid in abdomen. Ruptured ovarian cyst, left. Myomata uteri. Uterus and left ovary removed. Right rectus incision. Stones removed from gall bladder and cystic duct. Sections of the ovary show carcinoma. The patient died 2 years later of carcinoma. No return of gall-bladder symptoms.

CASE 7. Mrs. W. T. S. November 22, 1904. Symptoms for 12 years preceding operation. Stones removed and gall bladder drained. She was perfectly well until January, 1919, when she began to have gastric upsets. A palpable tumor soon appeared in the region of the pylorus. Death in December, 1920, from carcinoma of the stomach.

CASE 8. Mrs. J. W. July 8, 1920. A few gall-bladder attacks. Appendectomy. Stones removed and gall bladder drained. Carcinoma of the breast later and death from metastases. No return of gall-bladder symptoms.

CASE 9. Mrs. E. K. June 8, 1907. Pain and intermittent jaundice for 2 years. Marked jaundice at time of operation. One hundred stones removed. Gall bladder drained. Death several years later from cardiorenal condition.

CASE 10. Mrs. L. T. February 8, 1910. Definite gall-bladder attacks. Compensated cardiac lesion at time of operation. Pericholecystitis found. No stones. Adhesions released. Gall bladder drained. Sudden death from "heart trouble" 3 years later.

CASE 11. Mrs. E. S. May 6, 1908. Definite gall-bladder symptoms. Adhesions released, frank pus in gall bladder. Stones removed and gall bladder drained. Death several years later from a cardiorenal condition.

CASE 12. Mrs. J. R. E. September 17, 1899. Acute attack of 2 weeks' duration. Marked jaundice. Clay-colored stools. Bile in urine. Temperature 103°. Stones removed from gall bladder and cystic duct. Complete recovery. Died at age of 76 from a cardiorenal condition—24 years after operation.

CASE 13. Mrs. E. L. January 10, 1903. Adhesions released, stones removed. Death some years later from chronic interstitial nephritis. No return of gall-bladder symptoms.

CASE 14. Mrs. E. N. June 21, 1918. Mid-line incision. Modified Gilliam suspension of the uterus. Appendectomy. Stones removed and gall bladder drained through a right rectus incision. Perfectly well until June, 1921; a little later died of acute nephritis.

CASE 15. Dr. F. J. O. October 23, 1918. Appendectomy. Stones removed and gall bladder drained. In December, 1920, the patient collapsed with signs of uræmia and soon died.

CASE 16. Mrs. C. R. March 11, 1909. Acute cholecystitis. A thin frail woman with a cardiac condition and partial decompensation at time of operation. Two large stones removed. No return of symptoms. Death in 1912 from lobar pneumonia.

CASE 17. Miss E. L. R. November 27, 1908. Chronic cholecystitis and cholelithiasis. Stones removed and gall bladder drained. Death several years later from pneumonia.

CASE 18. Mrs. K. H. June, 1908. Chronic cholecystitis and cholelithiasis. Acute exacerbation. Stones removed. Wall of gall bladder 6 millimeters thick, very friable. Perfectly well for 12 years. Death from pneumonia.

CASE 19. Mrs. S. June 26, 1901. Pleurisy and pneumonia 3 years before operation. Abscess found between abdominal wall and liver. Gall bladder involved. The patient made a satisfactory recovery and lived 16 years. She died of pneumonia.

CASE 20. Mr. J. H. March 11, 1911. Acute cholecystitis. Gall bladder adherent. Large amount of gritty material obtained. No return of gall-bladder symptoms. Death from bronchopneumonia.

CASE 21. Mrs. J. W. H. February 13, 1914. Chronic cholecystitis. Stone removed from gall

bladder. Patient recovered completely. Death 6 years later from cerebral hæmorrhage.

CASE 22. Mrs. H. O. B. April 30, 1912. Chronic cholecystitis with acute exacerbation. Many stones removed from gall bladder. Several removed from the cystic duct. Complete recovery. Death 8 years later—apoplexy.

CASE 23. Mrs. A. March 25, 1908. Acute symptoms for 3 days. A very fat woman. Acute bronchitis. Albumin and casts in urine. Gas anæsthesia. Fifty stones removed. Gall bladder gangrenous. Complete recovery. Death 11 years later—apoplexy.

CASE 24. Mrs. H. S. April 11, 1905. Intermittent attacks for 8 years. Acute exacerbation at time of operation. Stones removed from gall bladder and cystic duct. No return of symptoms. Over 80 years old at time of death. Cause of death, "complications."

CASE 25. Mrs. R. March 6, 1909. General peritonitis at time of operation, thought to be due to a ruptured gangrenous gall bladder. Exudate over liver, stomach, and colon. Gall bladder drained. Appendix normal. Recovered. Death several years later, cause unknown.

CASE 26. Mrs. A. P. August 19, 1902. Chronic cholecystitis. Adhesions released. Gall bladder drained. No return of symptoms. Cause of death, unknown.

CASE 27. Mrs. E. B. April 25, 1911. Acute attack at time of operation. Stones removed. Gall bladder drained. The patient lived 9 years. No return of symptoms. Cause of death, unknown.

CASE 28. Mr. S. July 10, 1911. Symptoms for years, exacerbation at time of operation. Few stones, large amount of putty-like material and some pus. Cystic duct not obstructed. Death 4 years after operation. Cause, unknown.

CASE 29. Mrs. L. D. December 31, 1915. History of several acute attacks. Onset of last attack 24 hours before operation. One hundred stones removed. No return of symptoms. Death 3 years later from Hodgkin's disease.

CASE 30. Mrs. A. D. May 17, 1919. Chronic cholecystitis. Exacerbation at time of operation. Gall bladder quite adherent. Many stones removed from gall bladder and cystic duct. No return of symptoms. Death from pellagra.

CASE 31. Mrs. R. H. McB. July, 1918. Chronic cholecystitis. Diabetes. Operation delayed 6 months because of severity of diabetes. Appendix removed. Stones removed from gall bladder. The patient did well for 1 year. Death due to diabetes.

CASE 32. Mrs. J. F. B. April 13, 1921. Gall-bladder symptoms for 15 years. Sixty stones found in gall bladder. The patient recovered, but about 1 year later developed a right perinephritic abscess and died soon after operation.

CASE 33. Mrs. S. C. D. October 1, 1903. Definite history of frequent attacks. No stones found. Numerous adhesions. Gall bladder drained. Complete recovery. She developed a psychosis and committed suicide years later.

CASE 34. Mr. J. D. April 22, 1920. Indigestion for 20 years. Gridiron incision. Appendix adherent, removed. Liver 10 centimeters below costal margin. Gall bladder far up under liver. Gall bladder drained. Papillomatous growth removed from pyloric end of stomach. Death about 3 years later from gastric carcinoma.

Deducting the patients who have died from any cause and those who have not been located, there remain 210 in our series who are living and have been communicated with. The results in these cases may be briefly summarized as follows:

Unimproved	*16
Improved	26
Well	168
	210

*Four of these were well but not until after second operation.

PREVAILING CONCLUSIONS

As far as I have gone, the prevailing opinion among gastro-enterologists about the postoperative complications in gall-bladder surgery seems to be that neither cholecystectomy nor cholecystostomy with drainage will prove satisfactory in all cases, so that it becomes a question of choosing the operative procedure which will give the highest percentage of recoveries. It is quite certain that in Dr. Cullen's hands the operative procedure described has produced excellent results.

What would have been the results in the present series of cases had cholecystectomy been the routine operative procedure? One might venture to say that the immediate mortality would have been much higher in the hands of the average surgeon and the percentage of recoveries would have been no better. Recurrences are possible even after cholecystectomy. In the very cases in which the gall bladder should be removed the patient's condition or the nature of the lesion may make its removal impossible. In these cases cholecystectomy would give a very high immediate mortality, and in case the patient survived, the postoperative complications would probably be just as severe and numerous as after cholecystostomy and drainage. In the very cases in which the gall bladder can be readily and is most frequently removed, one gets excellent results from drainage.

Unfortunately, we have not obtained complete bacteriological studies in our cholecystitis cases and the stones have frequently not been analyzed. It is suggested that these factors be studied more thoroughly in the future. The type of organism, or the formation of the stone, may have an important bearing on the decision as to the most appropriate operative procedure.

Whether we should remove the gall bladder or should drain it is still an unsettled question. After careful analysis of the present group of cases my own personal view is that drainage of the gall bladder is the safer and easier procedure in the hands of the average surgeon and in the average case. If a second operation should become necessary, cholecystectomy should be seriously considered. No hard and fast rules can be laid down. Each case must be considered by itself. We shall look forward with interest to the careful tabulation of gall-bladder results from other clinics, for it would seem that reports of large series of such cases, each coming under the care of the same surgeon, would go far to help in the solution of these problems.

In conclusion I wish to thank Dr. Cullen for placing at my disposal his excellent personal records of all his private patients and for his valuable assistance and suggestions in the preparation of the data and the writing of this paper. I wish also to thank Mr. Max Broedel for his striking illustrations. Miss Margaret Brogden, director of the Social Service Department of the Johns Hopkins Hospital, has kindly helped me to locate many of the patients. Miss Dorothy M. Collins has been of the utmost assistance in the typing and preparation of this paper.

I should be remiss did I not also express my sincere thanks to the physicians and relatives who have so kindly furnished me with the information relative to the patients.

THE TREATMENT OF DUODENAL FISTULA

With Report of a Case[1]

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UNDOUBTEDLY the occurrence of the usually serious and frequently fatal condition of duodenal fistula is far more common than the number of reported cases would lead one to suspect. In quite a careful search of the literature I am able to find only 28 cases. Complete reports are entirely wanting in several of these. Since the subject heading occasionally gives no information as to the occurrence of a duodenal fistula, it is not unlikely that a considerable number of case reports have been overlooked. However, others have commented recently on the scarcity of the literature on this subject; thus, Hendon (11) says that "the subject of duodenal fistula, traumatic in origin or otherwise, is accorded scant consideration by the majority of surgical authors."

There is no evidence at hand that any one has had much experience with this condition. Most writers base their remarks upon their experience with one or two cases.

Of the several stated primary etiological factors, by far the most frequent is trauma to the duodenum, either through operative procedures or from external violence. While operative trauma in these cases is sometimes intentional, as in transduodenal removal of a common duct stone, accidental injury, often not noticed at the time, is much more common and, obviously, also much more serious. Of these accidental operative traumas, injury to the duodenum through including a part of it in the bite of a pedicle clamp in right side nephrectomy, has been emphasized by W. J. Mayo (16) who has seen three such cases, all of which terminated fatally. Injury to the duodenum with resulting fistula formation has been reported a number of times in operations on the gall bladder and biliary ducts. In some instances it has been a laceration, either recognized at the time and closed immediately or not recognized and consequently left open.

The evidence is overwhelming that the gauze pack has resulted in the formation of a number of fistulæ, especially in cases in which an opening in the duodenum has been closed and the gauze pack inserted against the suture line. Frequently the fistula has first appeared immediately upon the removal of the pack on the fourth or fifth day, or, as happened in one case, at the end of 3 weeks. It is evident that the gauze pack should never be employed in such cases; yet it is still advocated and used in these very cases by some surgeons.

Laceration and rupture of the duodenum with fistula formation have followed blows and kicks on the abdomen and other forms of external violence.

After trauma comes perforated duodenal ulcer as the second most common primary etiological factor. In these cases in particular the gauze pack should be feared.

Leakage in the suture line of the closed end of the duodenum, in gastric resection cases, is apparently one of the less frequent etiological factors. This leakage may result from an imperfectly applied suture, or, as probably happens more frequently, to the breaking-down of the suture line several days after operation. At any rate, most severe forms of duodenal fistulæ occur in these cases, according to Furtwaengler (9). The case reported in this paper is of this type.

Several other much more infrequent primary etiological factors are to be found in the abstracts of the reviewed cases which are recorded at the end of this paper.

[1] Since sending this article to the publisher I have accidentally discovered a very brief report of a case of duodenal fistula by Dr. Seward Erdman, in which he states that a suction apparatus was employed in the treatment of the fistula. Two figures illustrating the suction apparatus accompany the report. This case was reported before the New York Surgical Society, February 9, 1921. The transactions of this meeting were published in *Annals of Surgery*, 1921, lxxiii, 793–795. This is the only report of the employment of a suction apparatus in the treatment of a duodenal fistula of which I have knowledge, and the reason I overlooked it is apparent when one consults the *Quarterly Cumulative Index to Medical Literature* and the *Index Medicus* for this period, in neither of which is this report listed.

There are a number of contributing factors which are of the greatest importance at times. They all may be present in one case and lacking in another. They are (1), the proteolytic action of the duodenal discharge; (2) infection; (3) the considerable intraduodenal pressure at times; and (4) the greatly diminished resistance of the patient.

The highly irritating and destructive action of the duodenal discharge, which manifests itself so strikingly at times, is due for the most part to the contained trypsin. The tissue of the duodenal wall, when sufficiently impaired through trauma or disease, is disintegrated readily by this powerful enzyme which is active "in neutral as well as in slightly acid or markedly alkaline solutions" (Howell, 12). Once outside the bowel it readily attacks normal tissue with the result that this rapidly progressive destructive process will end fatally if unchecked.

Infection is frequently of great importance. Besides having its origin in the duodenum itself, it often extends to this structure from the kidney or gall bladder, sometimes with abscess formation. The infected tissue is readily attacked by the tryspin.

The sudden increase of the intraduodenal pressure through delivery of gastric content is obviously a factor in the giving way of a weakened area in the duodenum; also the peristalsis thus created is a factor detrimental to the repair of a defect in the wall of this structure.

No doubt local tissue resistance is lessened considerably in those cases in which nutrition suffers severely.

The time of appearance of duodenal fistula following a primary condition varies considerably. Sometimes several weeks intervene, although this is unusual. As a rule, it develops within 4 to 9 days. The amount of discharge is usually small at first, but frequently increases rapidly, becoming enormous at times. In some cases, particularly those in which no tryptic action is manifested, it is slight at all times. The amount and also the character of the discharge are modified greatly by the quantity of food and water taken *per os*. Bile is not constantly present, particularly if the duodenal defect is located a considerable distance proximal to the ampulla of Vater; likewise tryptic action is less apt to be present under similar conditions.

The most important factor influencing the appearance of the tissues of the fistulous tract and the surrounding skin is the presence or absence of trypsin in the discharge. When it is present the surrounding skin is markedly inflamed, eroded, and macerated, becoming darkly discolored at times. The extent of skin involvement is sometimes enormous. It is frequently limited to the area covered by the saturated dressings. Palmer (21) states: "The digestion of the skin of the abdomen and back is so rapid and unrelenting as to make the life of the patient a hardship to himself because of the discomfort and pain, and to the nursing force because of the frequency of the needed dressings."

The fistulous tract often opens into a widely gaping abdominal wound which is open throughout a greater part of its length. Its surfaces are usually acutely inflamed. Here and there may be seen bleeding points. Hæmorrhage from the wound is sometimes serious. Fat necrosis is rarely present.

In most cases the diagnosis offers no difficulty. The escape of characteristic duodenal contents is conclusive evidence. At times, especially in the onset, the diagnosis may be doubtful as, for instance, when the discharge is non-irritating, not excessive, and contains bile with no striking evidence of gastric content.

The clinical course of these cases varies greatly, depending upon the character of the fistula. There are all graduations, from the type characterized by a minute opening in the duodenum with only a slight non-irritating discharge, to the type in which the discharge is enormous and frightfully destructive. Spontaneous healing may occur in the first type but never in the second. Ordinarily, spontaneous healing does not occur in duodenal fistulæ. The rule is that the condition becomes progressively worse and ends fatally unless treated.

The progress of the condition is rapidly fatal in those cases in which practically the entire duodenal content escapes by way of the fistula. The enormous interference with

metabolism together with the local destructive process may result in death in 2 or 3 days. This rapid depletion is not present in those cases in which the gastric content enters the jejunum by way of an artificial stoma, as, for instance, in gastric resections of the Billroth II and Pólya types.

The most frequently stated causes of death are exhaustion, emaciation, and peritonitis. Probably another cause of death is a toxæmia, other than bacterial, such as Kanavel (13) has described in extraperitoneal rupture of the duodenum.

The prognosis is usually grave. In 1914 Pannett (22) said that "as far as can be ascertained from writings of the last 10 years, a duodenal fistula never heals without surgical aid, and, if left, is invariably fatal." This is too sweeping a statement in view of some of the case reports of the last few years in which spontaneous healing did occur; also, some cases treated non-surgically cleared up promptly and completely. This same writer added further that "recovery from a duodenal fistula, even with adequate surgical treatment is a rarity. Only three cases are to be found in the writings of the last 10 years." According to McGuire (19) the condition is a serious one and the best method of dealing with it has not yet been clearly settled; he says also that "usually the destructive action of the digestive secretions causes the fistula to enlarge, and unless there is surgical intervention the patient dies." Hendon (11) reports that "regardless of its mode of origin, duodenal fistula represents an exceedingly dangerous lesion." In speaking of duodenal fistulæ with outpouring of duodenal content, particularly the pancreatic juice, Einhorn (7) states that the prognosis is "very grave indeed." Referring to fistula due to duodenal trauma from nephrectomy, W. J. Mayo (16) states that "a most distressing type results which will often, if not usually, cause the death of the patient." In this series of twenty-eight cases the mortality is approximately 43 per cent.

Numerous operative and non-operative measures have been employed in the treatment of this condition, all of which aim at the same ultimate result, namely, the closure of the duodenal defect either by means of suture or spontaneously. Unhappily the closure by means of sutures is usually a failure as the suture line may give way sooner or later. Excluding Souttar's (19) case, because of lack of details, this operation, either alone or in conjunction with some other, was performed six times, with five failures. The one successful case is that reported by W. J. Mayo (17). In this case a perforation on the posterior duodenal wall, secondary to surgical procedures on the right kidney in the presence of infection, was closed as soon as observed. The situation of the defect in the other five cases was on the anterior wall three times and once it involved both the anterior and posterior surfaces. Information is lacking in one case.

From this evidence it would seem that this procedure is unwarranted in most instances, particularly in cases where the defect is large and its borders unfavorable for wound healing. If the opposite conditions prevail, which is quite unusual, then this procedure alone or in conjunction with some other may be looked upon favorably.

With immediate closure out of the question, one or two very serious conditions frequently confront one. As a rule either of these conditions, if not corrected, leads to a fatal termination. The first and more serious of these is the discharge through the fistula of everything which enters the duodenum from the various sources. Rapid loss of strength and resistance results, and death occurs within a few days. The second condition is the powerful digestive action of the pancreatic juice on the fistulous tract, the wound, and the surrounding skin. This may give rise to early peritonitis.

The treatment in these cases aims at the spontaneous closure of the duodenal defect through the correction of these unfavorable conditions. The methods employed are operative, medicinal, and mechanical, either alone or in combination.

Of the operative procedures the following have been employed: (1) gastro-enterostomy, (2) gastro-enterostomy plus pyloric occlusion, and (3) jejunostomy.

Gastro-enterostomy alone has been uniformly unsuccessful as the stomach does not

empty through the artificial stoma; in other words, this operation accomplishes nothing in the presence of a patent pylorus.

Gastro-enterostomy with occlusion of the pylorus, which was advocated first for these cases by Berg (2), is a very satisfactory procedure so far as the two alarming conditions previously mentioned are concerned. However, in many instances, the patient's general condition is so poor when this operation is performed, that death results. Another serious objection to this or any other operative procedure which involves the infected fistulous tract is the great danger of peritonitis. Furthermore, this operation is out of the question in fistula cases following gastric resections of the Billroth II or Pólya types, for here the altered anatomical relation of the stomach to the duodenum and jejunum is exactly what the Berg operation accomplishes. In these cases a duodenal fistula may not only fail to close spontaneously but actually develop, in spite of a gastro-enterostomy together with what amounts to a pyloric occlusion.

Jejunostomy is a much simpler procedure than the one just described and does not imperil the life of the patient nearly as much, either because of its extent or the danger of peritonitis. It accomplishes a great deal, spontaneous closure of the fistula occurring in favorable cases.

Medication to curtail or to inhibit the secretion of digestive ferments accomplishes little if anything. The withholding of food *per os* is important in this connection; also, it does away with a mechanical factor of some importance in interfering with the closure of the fistula. Rectal feedings for a period long enough to insure healing of the fistula do not suffice when food is withheld *per os*, so some other method of feeding has to be resorted to.

Attempts at neutralization of the trypsin in the duodenal discharge are futile, especially so when alkaline solutions are used for the purpose, since this ferment is active even in markedly alkaline solutions. A fairly strong acid medium will curtail or inhibit tryptic activity but can not be employed satisfactorily due to injury to the tissues.

Ointments and rubber solution applied to the skin aid greatly in protecting it. Liquid petrolatum has been given *per os* as well as applied locally to coat the surface of the fistulous tract.

In order to dilute the trypsin contained in the the fistulous discharge so that wound healing could take place, Cheever (4) and later Palmer (21) directed a continuous stream of water into the fistula over a period of days. Palmer added an alkali to the water. This measure gave favorable results so far as the fistula is concerned in these two cases, but was extremely laborious and sloppy, and in Palmer's case it had to be discontinued because of extensive irritation to the surrounding skin from the overflow on to it.

Packing the fistulous tract with gauze saturated with something such as olive oil has been done in mild cases. Obviously, there are numerous objections to this method, especially in the presence of marked infection and tryptic action.

Recently Einhorn employed a jejunal tube very successfully in the treatment of two fistula cases, in one of which the tryptic action was pronounced while it was absent in the other. This tube was in place 2 days after its introduction *per os*. By means of it, two very important things are accomplished, namely the satisfactory administration of food and water over a prolonged period of time, and, second, the marked curtailment or inhibition of the discharge from the fistula. Thus, at little or no risk to the patient, conditions favorable for the spontaneous closure of the fistula are brought about. This procedure fails in pyloric obstruction cases and would probably be carried out with difficulty in some gastric resection cases of the Billroth II type.

A short time ago I employed a highly satisfactory and extremely simple procedure in the treatment of a duodenal fistula patient whose condition was very serious, because of the rapidly progressive and destructive tryptic action involving extensive skin areas and the abdominal wound. I refer to the employment of a continuous suction apparatus such as is frequently used in the treatment of wounds in which the drainage is considerable.

Upon reviewing the literature, after having treated this case in this manner, I was unable

to find a case report where such a procedure was ever carried out. This is particularly worthy of note in view of the fact that only recently, as has been mentioned already, several cases have been reported in which the local condition gave rise to the gravest concern and yet in its treatment laborious, sloppy, and, in some respects, quite unsatisfactory, non-operative measures were resorted to. It is true that Cheever, in 1915, mentioned the suction method of treatment, stating that it had been employed by Jones and Williams. However, he did not comment further on it, nor did he employ it. Apparently Jones and Williams made no report.

My case is that of a man upon whom I did a partial gastrectomy for carcinoma of the stomach, January 10, 1923.

An anterior Pólya operation was performed. The free duodenal stump was rather short and was closed with some difficulty by means of a Connell and two continuous Lembert sutures; chromic catgut was used for the inner row and linen for the two outer rows of sutures. A soft rubber (Penrose) drain was inserted down to the suture line. The abdominal wound was closed in the usual way. Nothing was given the patient *per os* for 4 days; then fluids and semisolid food were given. Until the sixth day there was nothing noteworthy in the patient's condition. On the seventh day, bile was first observed in the discharge from the wound, which had been serous in character and moderate in amount until then. This bile-colored discharge increased in amount quite rapidly, becoming profuse in a few days. On the eleventh day the discharge was noticed for the first time to be irritating to the surrounding skin, which was found to be severely inflamed. The extent of the cutaneous involvement corresponded exactly to the area of skin which was covered by the saturated dressings. Zinc oxide ointment was applied to the involved skin area. On the twelfth day the local condition was very much worse; a wide cutaneous area, surrounding the fistula, was acutely inflamed and blood oozed in places. The wound had opened up in its middle half; its surfaces were likewise intensely inflamed and were bleeding slightly in places. No fat necrosis was found on numerous careful examinations. The patient complained of severe burning pain in the involved area. While the general condition was excellent at all times, the local condition was alarming. The discharge was so profuse and irritating that the dressings had to be changed every 1 or 2 hours. It was at this time that an ordinary rubber catheter with several added openings was introduced into the fistulous tract as far as possible; it was then connected up with an electrical suction apparatus

Fig. 1. Suction apparatus in place, as used in the treatment of the author's case of duodenal fistula.

which was run continuously for the next 11 days. Five to seven hundred cubic centimeters of bile-colored material were thus recovered every 24 hours, with no discomfort whatever to the patient and also with no effort as far as the nursing staff was concerned. But what is of the greatest importance, the local condition began to clear up remarkably fast almost immediately. The skin was irritated no longer and the fistulous tract very little, if any, since the discharge was removed just as soon as it escaped from the duodenum. Marked tryptic action of the recovered material was demonstrated by both the Gross and Mett tube methods. Within 4 or 5 days the irritated skin appeared nearly normal. By this time, too, the wound and fistulous tract were well on the way to closure by granulation tissue. On the eleventh day after institution of this suction treatment the discharge stopped quite abruptly and completely.

The patient's diet was never interfered with during this treatment. His general condition improved all the time. He was discharged 1 week after cessation of the discharge. At that time his wound was healed completely.

Although the general condition of this patient was good at all times, since there was no appreciable disturbance in nutrition incident to the fistula, still there did exist an extremely serious condition, namely, a rapidly progressive and extensive destruction of tissue which apparently would have terminated fatally if unchecked. By the employment of an extremely simple apparatus, and with no discomfort to patient or nurse, all that could be desired in the way of a rapid, spontaneous healing of the duodenal defect was accomplished. It should be emphasized, too, that this procedure can be instituted immediately

upon discovery of a fistula and with no risk whatsoever to the patient. Much time would have been saved had this been done in this case, since the destructive process would have been wholly prevented.

CONCLUSION

Because of its great effectiveness, extreme simplicity, general adaptability, and freedom from danger, the suction method of treatment in local destructive processes in duodenal fistula cases should always be employed whenever this condition continues to exist.

This procedure alone will suffice in the treatment of certain types of serious cases. It often can be combined advantageously with other methods of treatment.

CASE REPORTS FROM THE LITERATURE

CASE 1. Berg's (1) first case: A cholecystduodenostomy was done with a Murphy button in a case of obstructive jaundice due to a carcinoma of the head of the pancreas. Five days later a duodenal fistula developed. The duodenal defect was closed by suture but re-opened on the fourth day. An anterior gastro-enterostomy with a Murphy button was done; at the same time the pylorus was occluded by means of a silk ligature. Eleven days later, as the ligature cut through, the occlusion of the pylorus was maintained by inverting the gastric and duodenal walls over the line of the ligature. There was never any discharge of chyme from the duodenal fistula after the gastro-enterostomy and pyloric occlusion. Death occurred 17 days after the last operation from exhaustion.

CASE 2. Berg's (1) second case: Patient had a perforated duodenal ulcer about the size of a pea, which involved the anterior surface of the first part of the duodenum. The edges of the ulcer were gangrenous. The perforation was closed with three layers of Lembert sutures. Seven days later the suture line gave way and a fistula occurred. A posterior gastro-enterostomy was done; at the same time the opening in the duodenum was closed again. Two days later the suture line in the duodenum gave way again. Several more attempts were made to close this opening, all of which failed ultimately. Ten days after the gastro-enterostomy operation, the pylorus was occluded by means of a broad tape. There was no fistula leakage during the next 24 hours. The patient died without ever having rallied from the operation.

CASE 3. Cameron's (3) case: A man suffered from a duodenal fistula, which refused to close. A posterior gastro-enterostomy was performed but the fistula refused to heal, and the intestinal contents still escaped. A second laparotomy was performed, the pylorus was ligated, and the fistula healed almost immediately.

CASE 4. Knagg's (14) case: A fistula developed secondary to an operation through the right loin for opening an abscess. A drainage tube was inserted. Later the sinus tract was opened and the fistula developed within a few days. It persisted for weeks. About 3½ months later (after onset of fistula) a posterior gastro-enterostomy was done and the pylorus infolded by two rows of Lembert sutures parallel to its long axis. There was marked immediate improvement in the fistula and ultimate recovery.

CASE 5. Esau's (8) case: An abscess in the right kidney region of one month's duration was opened. It followed a blow in the right side. A lacerated and infected kidney was removed also, and the wound was loosely tamponaded. The pack was removed at the end of 3 days and a new one inserted. A fistula developed the same day. With no further comments the author states that pancreatic juice was apparently present in the discharge. Closure of the opening, which was the size of a mark, was out of the question, due to its inflamed, œdematous, ragged, and friable margin. On the third day after the appearance of the fistula a jejunostomy (Y-shaped) was performed. Death occurred 6 days later from exhaustion.

CASES 6, 7, 8. Collective report (Struthers et al, 24). In a series of perforated duodenal ulcers "a duodenal fistula developed in the three cases in which the perforation was not closed at the time of the operation. All three cases died within a few days with rapid emaciation and asthenia."

CASE 9. Winiwarter's case (26): A rupture of the pars horizontalis duodenum was sustained following a kick on the abdomen. The entire anterior wall and a part of the posterior wall were involved. Closure was made after 24 hours with three rows of sutures. The mesocolon was sutured to the place of closure. A gauze pack was inserted. A fistula developed 2 days later. The margins of the skin were darkly discolored. Abundant wound secretion escaped. The general condition was good for 4 days and then declined rapidly. Salt solution and nourishment were given per rectum. On the sixth day dehydration and loss of strength were marked. The discharge from the wound was copious. An enterostomy (nearest loop) was done to give nourishment. Death occurred 2 days later from peritonitis.

CASE 10. Thévenard's (25) case: A fistula developed "secondary to a sinus of 10 years' duration, following a nephrectomy. The fistula was probably tuberculous and had shown intermittent abscess formation. Healing of the fistula followed gastro-enterostomy plus pyloric exclusion."

CASE 11. Souttar's (18) case: "The fistula resulted from the perforation of an ulcer of the duodenum following an extensive burn in a child. Bile and pancreatic juice escaped for 9 days. The abdomen was explored, the ulcer found and sutured, posterior gastro-enterostomy performed, and, finally, the pylorus was infolded. The child recovered."

CASE 12. Case seen by Mayo (16): A nephrectomy was done on a kidney on which a nephrotomy had been performed. Pedicle clamps were left in place. "On the fourth or fifth day a copious discharge began of biliary and pancreatic secretions, with food discharged almost as quickly as taken. The patient became rapidly exhausted and died in 2 weeks."

CASE 13. Mayo's (16) case: A nephrectomy was done for a carcinoma of the pelvis of the kidney. Heavy toothed forceps were applied to some vessels which were torn across. The forceps were left *in situ*. A duodenal fistula was discovered on the fifth day. The discharge was profuse. Death occurred 5 days later. Autopsy showed the fistulous opening to be in the descending portion of the duodenum.

CASE 14. Case seen by Mayo (16): A fistula developed following a nephrectomy, which was undoubtedly due to trauma to the duodenum through the application of heavy forceps after the kidney had been torn loose from an infiltrated pedicle. "The fistula was small at first, but gradually increased in size." Death occurred 2 weeks later. "One feature in all these cases (11, 12, and 13) was the action on the skin of the escaping secretions. Large areas of the neighboring integument became scalded, painful, and

irritated. In one patient this set up a rapidly spreading eczema and in a week a great part of the skin of the body was affected."

CASE 15. Pannett's (22) case: Upon operation a perforated duodenal ulcer was found on the anterior wall of the first part of the duodenum. The size of the perforation was approximately equal to the diameter of a lead pencil. This perforation was closed with three rows of non-absorbable sutures. Gauze drain was inserted down to the site of perforation. With removal of this gauze on the fourth day a fistula developed, from which the discharge was profuse. Food was withheld *per os* and rectal feedings, also glucose and saline injections, were resorted to, but the patient's condition became desperate. By the fourth day after the fistula developed the wound was widely gaping, and the edges were infected and partly digested by the pancreatic fluid. A jejunostomy of a type original with the author was performed and feedings carried out through the new opening. Spontaneous healing of the fistula resulted in a short time.

CASE 16. Mayo's (17) case: A sinus developed secondary to a pelviolithotomy. The sinus was enlarged and finally a strip of iodoform gauze was placed in the wound. The next day a fistula developed from which, upon removal of the gauze on the second day, "there was an abundant discharge of bile, pancreatic and duodenal secretion, and some particles of food." At operation, which was performed immediately, an "opening of sufficient size to admit the end of a finger was found in the posterior wall of the duodenum (posterior attachment)." This opening was closed by sutures and an uninterrupted recovery followed.

CASE 17. Cheever's (14) case: "A traumatic rupture of the duodenum on its posterior aspect, about 3 centimeters distal to the pylorus" was both intraperitoneal and extraperitoneal. This opening was closed with chromic catgut 8 hours after the injury. Drains were inserted down to the site of injury. Five days later a duodenal fistula developed. The fistulous discharge was profuse and extremely irritating, "causing the wound to re-open throughout its length, undermining the skin and rapidly digesting the skin edges and the tissues of the abdominal wall." A small rubber tube was carried down to the bottom of the wound, and held in place by appropriate means, and a continuous irrigation of the sinus with sterile water inaugurated, the overflow being conducted into receptacles by means of banks of rubber tissue." Due to the dilution of the discharge, there was immediate cessation of the destructive process. "This continuous irrigation was continued for 5 days and nights." Leakage soon stopped and recovery occurred.

CASE 18. Gardner's (10) case: A fistula about the size of a lead pencil was found at operation between the fundus of the gall bladder and the duodenum. A stone was "milked out" of this fistulous tract. The gall bladder, which had been opened, was carefully closed. On the ninth day a foul, purulent discharge, which later excoriated the skin, appeared and persisted for about a month. The patient recovered. Gardner thinks that the duodenal discharge escaped by way of the gall bladder.

CASE 19. Davis' (5) case: A small fistula existed between the duodenum and the kidney pelvis, about 1 square centimeter of the periphery of the duodenum being involved in adhesions. In doing a nephrectomy this fistulous tract was cut through. Its opening into the duodenum was too small to be readily found. The kidney incision was closed with ample drainage. "On the fourth day there appeared a profuse watery discharge," which irritated the skin bordering incision. Discharge gradually lessened and ceased by twelfth day. Healing eventually occurred.

CASE 20. Palmer's (21) first case: A gastric resection of the Billroth II type was performed. The duodenal stump was closed with difficulty. On the eighth day, following a full meal by mistake, a fistula suddenly developed. Rapid and extensive digestion of the surrounding skin followed. "Immediately food was withheld by mouth; atropine and sodium fluorid, 1 grain, were given by mouth to inhibit pancreatic activity. Sodium fluorid, 1 per cent, was also used as a wet dressing over the abdomen and injected along the fistulous tract. Paraffin of low melting point was frequently and freely painted over the skin. The discharge of bile and pancreatic fluids ceased after 8 days." Six days later the wound and skin were thoroughly healed.

CASE 21. Palmer's (21) second case: A common duct stone was removed by the transduodenal route. The duodenum was closed with three rows of No. 1 chromic catgut. A rubber drain but no gauze was inserted. On the sixth day, upon loosening the drain, a duodenal fistula developed; the drainage became very profuse and caused "rapid and extensive digestion of the skin of the abdomen in a few hours." Everything *per os* was immediately stopped except for medication. Glucose and sodium bicarbonate were given per rectum. Sodium bicarbonate was given *per os*. Atropine was administered for several days. Sodium fluorid was given *per os* in 1 grain doses and was employed in 1 per cent strength in an irrigating solution directed into the fistula. The abdomen was covered with paraffin. In spite of this the "quantity and irritability of the discharge increased. On two occasions the dressings were saturated with blood. On the twelfth day a No. 14 catheter was inserted to the depths of the fistula, through which a continuous drop irrigation of the tract with soda solution was carried out. This was continued until the patient's back became so sore through digestive action of the fluid running into the Kelly pad under him that it had to be discontinued" in spite of marked improvement. Later fluids were given *per os*, also large doses of liquid petrolatum to coat the fistulous tract. The fistula was frequently plugged with zinc oxide. Recovery eventually occurred.

CASE 22. Einhorn's (6) first case: A duodenal fistula developed 17 days after an unsuccessful attempt at operation on a biliary fistula following a cholecystectomy. The patient complained of an intense itching and burning in the wound. The skin around the fistula became eroded. The discharge from the fistula contained bile, pancreatic juice, and food particles. Trypsin was tested for and found. The condition of the patient was serious. Two days later a duodenal tube was passed *per os*. It entered the duodenum 2 days later. Milk, lactose, and saline solution were then administered successfully through this tube. Within 2 weeks the irritated skin had cleared up and the discharge from the wound had diminished greatly. The duodenal fistula had closed 17 days later.

CASE 23. Hendon's (16) case: A duodenal fistula developed in a patient upon whom a number of operations had been performed on the biliary passage. The gall bladder had been removed. An attempt was made to establish a permanent biliary fistula. A drainage tube was inserted into the wound and gauze packed around it. The next day the duodenal fistula was evident. The discharge was very profuse. "Oakum pads were used to absorb the discharge. The skin was protected with a rubber dam and the fistula was packed every day with gauze strips saturated with compound tincture of benzoin." The fistula closed within 5 weeks.

CASE 24. Einhorn's (7) second case: Upon removal of a very adherent gall bladder severe hæmorrhage was encountered from the exposed liver tissue. Three gauze tampons were inserted to control the bleeding. The last

tampon was removed 3 weeks later, when it was discovered that a duodenal fistula was present. The fistula persisted for 5 months. At times the discharge was abundant, but the surrounding skin was not injured since no pancreatic juice escaped. There was very little bile discharged. A duodenal tube (44 inches long) was inserted *per os*; 2 days later jejunal feedings were started. Improvement was soon noticed. There was a discharge off and on, for a time, but the fistula closed eventually.

CASE 25. McGuire's (19) case: The duodenum was torn into in removing the gall bladder in the presence of dense adhesions. This rent was closed with a double row of chromic catgut sutures. The common duct was drained by a tube, protective gauze and rubber tissue being placed about it. On the ninth day "there was a sudden and profuse discharge of gastric contents through the incision, evidently due to a duodenal fistula." Jejunostomy was performed. Water and nourishment were given exclusively by the jejunostomy. The result was immediate and gratifying. Spontaneous closure occurred in three weeks.

CASE 26. Stadler's (23) case: A right upper abdominal abscess, which was secondary to a ruptured gall bladder, was opened. The cavity was drained with a Kocher glass drain and the incision wound with iodoform gauze. On the ninth day a high intestinal fistula developed. Five days later the fistulous tract was tamponaded with a strip of gauze dipped in olive oil. The tampon was changed every other day. The fistula closed completely in a little longer than a month.

CASE 27. Koerte's (15) case: Due to a crushing injury the liver was lacerated. After suturing these lacerations the wound was tamponaded. A subphrenic abscess developed. A few weeks later a duodenal fistula developed. The next day blood escaped from the fistula. At operation a finger-sized opening in the duodenum was closed by suture and a jejunostomy performed. Death occurred 2 days later. Autopsy showed that death was due to peritonitis following the giving way of the suture line in the duodenum.

CASE 28. Furtwaengler's (9) case: Five weeks after a blow on the abdomen a right upper abdominal quadrant abscess broke spontaneously to the outside. A duodenal fistula was present apparently at this time. Skin around the fistula became reddened. The patient failed rapidly. At operation, performed 2 or 3 weeks later, a duodenal defect, on the external curvature of the inferior flexure, was closed with three rows of silk sutures. Two-thirds of this suture line was on the serous side and one-third was retroperitoneal. In addition to this a posterior gastro-enterostomy and a pyloric occlusion were done. For 9 days there was no intestinal drainage; then bile suddenly appeared. Death occurred 4 days later from peritonitis, due to leakage of the duodenal suture line.

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AN INQUIRY INTO THE USEFULNESS OF THE DUODENAL TUBE[1]

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THE object of this research was to determine the clinical applicability of duodenal drainage to diagnosis and treatment of the duodenal and biliary tract lesions with special reference to gall-bladder and bile-duct infection.

HISTORY OF THE DUODENAL TUBE

The history of the duodenal tube can be traced back to Einhorn (8) who has devised many useful gastric instruments, and who in 1909 used the tube for feeding peptic ulcer cases as well as applying it clinically in diagnosis. The first serviceable duodenal tube was the Rehfuss (18) but since then many different types, Buckstein (4), Palefski (17), Lyon (13), etc., have been introduced.

It remained, however, for Lyon (14) first, to show the value of duodenal drainage for purposes of diagnosis and treatment in diseases of the biliary system. Following Lyon, there have been many who have tried to prove or disprove his claims. Wide controversy exists as to the efficacy of this method in the cytological, bacteriological, and chemical studies of the bile recovered by means of duodenal intubation; on one side, the method boasts of its champions, Lyon, Smithies (20), Friedenwald (11), Whipple (22), Stewart (21) and others; while on the other side there are the skeptics, Einhorn (9), Dunn and Connell (7), Cronn Reiss and Radin (5), Auster and Cronn (1), Bassler Lucket and Lutz (2), etc.

In this paper I propose to give an impartial report of the actual findings in my investigation of five hundred cases.

ANATOMY AND PHYSIOLOGY OF THE BILIARY TRACT

In order to understand the mechanism of biliary tract drainage, it will be necessary to review shortly the different parts of the biliary system and to describe its peculiar nerve supply.

Anatomy. The biliary system is composed of liver, bile ducts, gall bladder, and common duct. The liver is a constantly secreting organ, selecting certain substances from the blood, transforming them and returning some back to the blood stream while others are excreted in the form of bile. This specific excretion of the liver passes down a series of small ducts in the liver substance, which unite to form the hepatic duct, which in turn unites with the cystic duct to form the common duct. The common duct empties the secretion into the duodenum and is controlled at its terminal end by a sphincter muscle. The gall bladder is a pear-shaped sac possessing a strong fibromuscular wall which has the power of changing a constant flow of bile from the liver to the duodenum into an intermittent one. The gall bladder is placed between the liver and the common duct sphincter muscle. When the sphincter of Oddi is closed, the gall bladder acts as a buffer and stores up bile which becomes concentrated within its walls and is used when demanded for digestion.

Innervation of the gall bladder and bile passages. The innervation of the gall bladder was specially studied by Doyon (6) in 1894. He showed that the gall bladder had a double nerve supply, from the sympathetic and from the vagus; that the gall bladder received both inhibitory and motor fibers through the sympathetic, while in the vagus, there also occurred both motor and sensory fibers, motor fibers to the sphincter and inhibitory fibers to the gall bladder. The vagus is the motor and secretory nerve to the gall bladder and bile passage. The sympathetic deriving its fibers from the ninth right intercostal segment is the sensory nerve to the gall bladder; it is inhibitory to the muscular wall, but supplies the motor filaments to Oddi's sphincter. Thus stimulation of the vagus causes emptying of the gall bladder through a relaxed sphincter and filling of the lax walled gall bladder with bile. Doyon's work was later confirmed by Freese (10), Oddi (16), and Meltzer (15). Meltzer stated: "It seems quite safely established that the physiological discontinuous character

[1]This research was conducted during the tenure of the Hudson's Bay Company Research Fellowship, University of Manitoba, for one year, under the direction of Dr. William Boyd, Professor of Pathology.

of the flow of bile into the duodenum is regulated by a reflex mechanism dominated by the 'law of contrary innervation.'" In 1917, while working with magnesium compounds, Meltzer found that magnesium sulphate when placed in the duodenum would cause a completely local relaxation of the intestine and thus relax the common duct sphincter, permitting the ejection of bile from the biliary tract into the duodenum. Therefore, as this discharge of bile was due to reflex contraction of the gall bladder from a relaxation of the sphincter of the common duct caused by magnesium sulphate, it suggested to Meltzer that in cases of jaundice and biliary colic the local application of magnesium sulphate to the duodenal mucosa might be of great value in permitting the ejection of bile and the probable removal of a calculus of moderate size.

THE EVOLUTION OF DUODENAL DRAINAGE

Lyon, of Philadelphia, became interested in Meltzer's work, and from this he evolved the method of duodenal drainage in man. Lyon theorized that if the above "law of contrary innervation" was sound, then anything which caused an inhibition of tonus of Oddi's muscle, must necessarily cause a contraction of the gall-bladder musculature. This I have found to be not true, for such drugs as benzyl benzoate, atropine sulphate, etc., will cause an inhibition of tonus of Oddi's muscle allowing the ejection of bile, but will not produce expulsion of the dark or gall-bladder bile. On the other hand, magnesium sulphate does call into action this antagonistic reaction of duct sphincter and gall bladder. Magnesium sulphate, 33 per cent, was used in most of the cases, with good results following.

Whether magnesium sulphate is a specific agent in stimulating the flow of bile from the gall bladder, or whether Meltzer's law of contrary innervation is correct, or B. L. Knight's (12) suggestion that the laws of osmosis is responsible, it is not within the scope of this paper to discuss. Suffice it to say that a wide controversy does exist, which can best be judged by the extensive literature written on the subject, pro and con.

Duodenal drainage—a clinical aid. The duodenal tube permits of making direct observations on the bile obtained from the several sources of the biliary system. It can be easily demonstrated that the use of magnesium sulphate, locally, delivers bile through the duodenal tube in varying quantities and of varying quality. It does this when the duodenum is previously bile free indicating that the solution of magnesium sulphate does relax the sphincter of the common duct; furthermore, it can be noticed that the character of the bile recovered by the duodenal tube undergoes certain definite changes in color and viscosity: first a light yellow to a golden yellow; then a deeper, richer, more syrupy golden brown; and finally to a thinner, less syrupy golden yellow. I have found that this sequence occurs in practically all apparently normal cases.

TECHNIQUE OF EXAMINATION

The following was the procedure used in my series of cases:

1. The patient is instructed to take a light supper the evening before the morning that the treatment is to be given, nothing being allowed by mouth, except water, after 10 p.m.

2. Before retiring, the teeth are brushed thoroughly, the mouth cleansed, and the throat gargled with an antiseptic solution; this is repeated again in the morning.

3. The tip of a freshly sterilized duodenal tube, dipped in sterile glycerine, is placed in the back of the patient's mouth and patient is instructed to swallow and then breathe out and the tube slips down past the glottis easily. (Patients will sometimes stop breathing and they think that they are gagging.)

4. The tube is swallowed to mark I, and the stomach is washed with warm sterile water. Potassium permanganate (1:12000), is not used any more to wash out stomach, because it nauseates most patients and consumes valuable time.

5. Patient is then ordered to turn on his or her right side, and swallow tube very slowly to mark III, taking about 20 minutes to do so.

The bulb of the tube should enter the duodenum in 20 minutes. Sometimes its passage is accomplished in 5 minutes, but rarely does it take more than 1 hour. The presence of the bulb in the duodenum may be determined by:

a. Duodenal "tug." When a slight pull is made on the part of the tube that is hanging from the patient's mouth, a characteristic resistance is felt; this tug is not experienced when the bulb of the tube is in the stomach.

b. Character of the aspirated fluid. There is a change in the quality of the fluid from that of the stomach, it is alkaline in reaction, pearly gray or bile stained in color, more stringy in consistency and contains few flocculi.

c. The failure to recover immediately any fluid taken by mouth. Water poured down the tube, when the bulb is in the stomach is returned almost at once, but if the bulb is in the duodenum any fluid instilled therein will not be returned. This can be tested out with such fluids as broth, milk, or a colored fluid.

d. The fluoroscope lends itself as the best check on the position of the tube. A view can be taken of the tube alone, *in situ*, or a view after the injection of barium sulphate into the tube. This method, however, is not very convenient and can be used only where there is an X-ray apparatus.

6. Duodenal contents are then collected by means of gravity siphonage. Under normal conditions the common duct sphincter remains closed, and little or no bile is present in the duodenum. Specimen of duodenal contents can be examined for the presence of pancreatic juices.

7. When no bile is obtained, then 50 cubic centimeters of warm sterile magnesium sulphate solution, 33 per cent, are instilled into the duodenum, then returned by siphonage; when the gall bladder is atonic it is sometimes necessary to re-stimulate with more magnesium sulphate solution to secure a flow of bile.

8. A few minutes after the salt solution has been returned, the common duct sphincter becomes relaxed and bile appears at first mixed with magnesium sulphate, then clear bile. This first bile that appears, usually a light lemon yellow, is considered to be common duct bile and varies in amount from 10 to 25 cubic centimeters. This bile is then collected in a specimen bottle and marked specimen 1. Cultures are also taken directly from the tube into the agar and broth cultures.

9. Suddenly the bile changes color, becoming a deeper, richer, more syrupy, golden yellow or brown or green. This is the gall-bladder specimen and appears normally in amounts from 10 to 90 cubic centimeters. When this change occurs the specimen bottles are changed and new cultures taken; these are labelled specimen 2.

10. Soon another change occurs, the bile becomes lighter again and much thinner than the two previous specimens. This is the freshly secreted bile from the liver. Bottles are again changed, cultures are taken and these marked specimen 3.

After the three samples are recovered and the cultures taken, Ringer's solution, 250 cubic centimeters, is slowly injected into the duodenum to wash out any of the infected material that may have escaped into the bowel. This solution is not siphoned back but allowed to remain in the duodenum.

The tube is then withdrawn very slowly. A little water poured down the tube while it is being withdrawn will prevent any bile from being brought up into patient's mouth.

There should be no difficulty experienced in passing the tube, if the operator exercises enough patience and does not hurry the process. During the time that the tube passes from stomach to duodenum, it is well to distract the patient's mind from himself and the duodenal drainage. This can be done in various ways; for instance by allowing the patient to read some interesting book or to listen to an operatic record on the Victrola. One patient who was very excitable, became most restless when the tube did not enter the duodenum after one half hour and he asked for the telephone to enquire of his broker, how certain stocks were fluctuating; as soon as he got through talking, duodenal contents began to flow from tube. Another man to compose himself would smoke his pipe while waiting for the bulb to pass into the duodenum, and this invariably would cause a flow of bile from the tube.

EXAMINATION OF SAMPLES OF BILE RECOVERED

The samples should be examined as quickly after recovery as possible, otherwise changes occur which alter the findings somewhat. I have noticed on a few occasions that after

completing a drainage at a private home and then having to travel back to the laboratory to examine the specimens, probably one hour after recovery, specimens which came away turbid and flocculent from the tube would become clear and transparent with but few flocculi. This, however, is not the rule. Most samples of bile change color, becoming darker and more turbid on standing any length of time because of the precipitation of bile salts and bile pigments and in this way confuse the microscopic picture.

Gross examination. Valuable information is to be gained from direct observation of the bile and its manner of discharge, the quantity of bile ejected, the color, turbidity, reaction, viscosity, the presence of mucus and clear or bile-stained epithelium, in the different samples recovered.

Microscopic examination. The samples of bile are centrifugalized as soon as possible and the deposit is examined while wet, just as is a urinary sediment, for pus cells, epithelium, ova and parasites (lamblia intestinalis, fluke disease, etc.), crystals of cholesterin and lecithin, and micro-organisms.

Permanent slides were made in about two hundred cases, three different stains being used for each sample of centrifugalized bile. Certain cellular structures, I found, showed to better advantage with a particular stain. The micro-organisms showed up best when methylene blue was used; most of the cellular structures took the hæmatoxylin and eosin stains very well; while the leucocytes and degenerated pus cells showed to best advantage with Jenner's stain.

In preparing the permanent slides, the wet-fixation method was used:

1. Small amount of deposit of centrifugalized bile was smeared on a glass slide or a cover slip and heated in the flame until just the edge of the film became dry.

2. Cover slip or slide was then gently immersed in a saturated solution of mercuric bichloride (to which 5 per cent formalin had been added), for purposes of fixing, and kept there for 30 seconds.

3. The fixed smear was then passed through absolute alcohol, then washed in running water.

4. Smear was next stained with the selected staining solution, methylene blue; hæmatoxylin and eosin; Jenner's stain. (When Jenner's stain was used, distilled water was used for washing instead of tap water.)

5. Smear was then washed in water, then xylol and finally mounted with Canada balsam. Each slide was then labelled and put away for future examination or reference.

PRESERVATION OF CELLS

As duodenal contents are a digestive juice, it was thought that digestion of the cells might take place which would alter the findings if the specimens were not examined on immediate recovery. To determine this a series of samples were tested out as to the preservation of their cytological content after 24 hours, 48 hours, and 72 hours, both at room temperature and when kept in the ice chest.

After 24 hours the cells were just as well defined but the field was more taken up with bacteria and yeasts; after 48 hours the cells were still quite definite but did not take the stain so well and were almost hidden by the extra number of bacteria and yeasts; after 72 hours some smears showed only clumps of organisms and yeasts, the cellular structures being either completely lost from the picture or very poorly defined. These samples were divided into two lots: one left at room temperature and the other kept in the ice chest, but no appreciable difference in the cytological content of the two lots was noticed.

Bacteriological examination. Three cultures on three different media were taken of each sample of bile. These were incubated for 24 and 48 hours, then examined and the organisms, if present, identified. Plain agar, bouillon, and blood serum, were the different media used. The last mentioned was later discarded because it was completely digested by the bile.

NORMAL APPEARANCE OF BILE AND DUODENAL CONTENTS

Before applying this method of drainage in the diagnosis and treatment of lesions biliary or duodenal, a knowledge of the normal appearance of bile and duodenal contents is

important. To gain this, a number of hospital patients with no apparent digestive disturbances were tried out as normal cases. Duodenal contents normally are free of bile, alkaline in reaction, pearly gray, fairly transparent, syrupy, stringy in consistency and contain few flocculi. In my series of normal cases, few samples of duodenal contents were not bile-stained. This I think was due to the presence of the bulb of the tube in the duodenum, acting as a foreign body and causing a relaxation of the normally closed common duct sphincter and ejection of bile into the duodenum. Bacteriologically, the duodenum was practically free from organisms, the bacteria most commonly encountered were gram-positive cocci and gram-positive bacilli.

Normal bile contains water, bile salts and bile pigments, cholesterol, lime, and neutral fats. The bile as it is obtained normally undergoes certain definite changes in color and viscosity. After being assured that the bulb of the tube is in the duodenum, magnesium sulphate, 33 per cent, is instilled, then allowed to return, and this is followed by a flow of bile. The normal flow of bile was found to be from 15 to 30 drops per minute. At first the bile is light lemon yellow to golden yellow in color, clear, no flocculi, amount 10 to 20 cubic centimeters, then there is a sudden change to a golden brown bile, syrupy and thicker than the first, rather opaque, no flocculi, amount 30 to 60 cubic centimeters, then a third change, the bile becoming thinner and lighter in color again, a golden yellow. Microscopically, the centrifugalized specimens of bile are free from pus cells, contain few epithelial cells, bile salts and crystals. Bacteriologically, no pathogenic organisms are observed. Chemically, bile is alkaline in reaction, contains biliary salts and biliary pigments.

FAILURE OF THE DUODENAL TUBE TO RECOVER BILE

The failure to recover samples of bile for analysis by means of the duodenal tube, may be due to a functional or a truly organic cause. Functional causes may be one or more, as nervousness, nausea, or pylorospasm. Extreme nervousness on the part of the patient, who has a drainage for the first time, does not allow the bulb of the tube to pass out of the stomach. The presence of a foreign body in the mouth (as the rubber tube), will often cause the patient to become very nauseated and the tube will be vomited up each time its passage is attempted. Pylorospasm is sometimes encountered and the bulb of the tube cannot enter the duodenum; when pylorospasm is present it is best to withdraw the tube and repeat the drainage at another time. I have not resorted to the use of atropine sulphate to overcome the pylorospasm in any of my cases, and have been successful in gaining an entrance to the duodenum by exercising a little extra patience or repeating the drainage a few days after.

An organic cause, however, might be responsible for the failure of the tube to enter the duodenum, as for instance, a tumor at the pylorus or adhesions from a healed pyloric ulcer causing obstruction of the pyloric canal, or in a case of visceroptosis, where the tube curls itself inside the stomach because it cannot travel up to the duodenum. This difficulty has been overcome at times by changing the patient's posture. Placing a pillow beneath the hips and raising the foot of the bed so that the patient's head is slightly lower than his hips has been found to aid the tube materially in its passage through the pylorus.

When one is assured that the bulb of the duodenal tube has passed through the stomach and is in the duodenum, and when, after repeated stimulation with magnesium sulphate, no bile is obtained, then the cause is common duct obstruction from stone or new-growth in the neighborhood of the common duct. In my investigation, two cases of carcinoma at the head of the pancreas involving the common duct (confirmed by autopsy), and one case of common duct obstruction by stone (confirmed by operation), were diagnosed beforehand with the aid of the duodenal tube.

INTERPRETATION OF DUODENAL FINDINGS

The samples of bile can be readily segregated as coming from the different parts of the biliary system and labelled accordingly. Each part can then be examined independently for infection of that part from which it came.

Common duct bile. Common duct bile exceeding 25 cubic centimeters suggests local stasis; if the bile is turbid, specific gravity greater than 1015 (before using magnesium sulphate), exhibits gross blood, crystals, calculi, flocculi of mucus or epithelium, and microscopically shows pus and desquamated epithelial cells, it means duct disease or cholangeitis. Catarrhal jaundice can be diagnosed by this means and is also amenable to treatment with the tube. Infection of the ducts, however, is usually a co-existent condition with some gall-bladder, liver, pancreatic, or duodenal disturbance.

Gall-bladder bile. The gall-bladder bile or second specimen varies in color from a dark greenish yellow, green brown, green pea, dark green to black. There has been much comment as to the source of this darker bile, whether it is from the gall bladder or the liver. In my opinion, this bile actually comes from the gall bladder, although there is probably mixed in with it some bile from the liver and the bile ducts, based on the following reasons:

1. According to Rous and McMaster the gall bladder exerts a most remarkable concentrating effect on the bile that passes through it; the color and viscosity of the second bile indicating a higher concentration, strongly suggests then that this bile comes from the gall bladder.

2. One function of the gall bladder is that of absorption (Boyd, 3). The daily excretion of bile from the liver, it is said, is as much as the excretion product of the kidneys, that is 1500 cubic centimeters, part of which is stored up in the gall bladder where absorption of the water (Rous and McMaster, 19) and cholesterol (Boyd) takes place, but in the diseased gall bladder the mucosa loses this power of absorption and the gall bladder distends to make room for the excess volume of bile that it is called upon to store. The gall bladder has the power to expand from its capacity of 1 ounce to that of 6 ounces. This, then, accounts for the 2 to 6 ounces of dark bile that is sometimes recovered from somewhere between the sphincter of Oddi and the liver.

3. In patients who have had their gall bladders removed and later come under my observation, the dark concentrated bile has not been ejected from the tube (except on one occasion), the color of the bile passing from the light lemon yellow or duct bile to that of the thin limpid, golden yellow bile of the liver.

4. In patients who have had their gall bladders removed, the contents of the gall bladders excised has proved to be identical with that dark bile recovered before operation (by means of the tube), for cellular structures and micro-organisms.

5. In patients suffering from clinical gall-bladder disease, treatment by duodenal drainage has showed a marked improvement in the patient's condition and the impression of an infected bile is changed to that of a normal bile.

The failure to obtain gall-bladder bile following the clear light yellow bile, after repeated attempts at different intervals, indicates obstruction of the cystic duct, due to stones, adhesions or pressure from without by a tumor in the neighboring viscera. Spasm of the small muscular band at the opening of the cystic duct into the common duct will not allow gall-bladder bile to be emitted, but if the drainage be repeated after a short interval of a few days, gall-bladder bile can be recovered, giving the patient relief and not allowing a wrong diagnosis of cystic duct obstruction to be made. Cystic duct obstruction due to some organic cause should not be diagnosed on a single drainage but a second duodenal intubation should be done to confirm the first findings.

An excess of gall-bladder bile, that is over 90 cubic centimeters, suggests gall-bladder stasis, which is the forerunner of gall-bladder disease in all its forms. Stagnation of bile in the gall bladder offers an ideal culture media for infective organisms if they happen to be present in the blood stream. With the presence of stasis and infection, the necessary factors for gall-stone formation, there is a predisposition to cholelithiasis. Gall-bladder stasis is due to non-functioning gall-bladder mucosa together with a hepatic disturbance, and if this can be detected early (as it can by means of duodenal drainage), the condition can be treated and serious surgical gall-bladder disease prevented.

Besides noting the quantity of bile ejected in this gall-bladder specimen, additional in-

formation can be obtained from observing the gross changes, as foul odor, blood, pus, crystals, flocculi of clear or bile-stained mucus and epithelium; then the microscope and culture tube offer further evidence.

Liver bile. Thirdly, we get a sample of bile which is golden yellow and thinner than the first two specimens—the freshly secreted bile from the liver. This comes from the hepatic cells and ducts and shows definite changes if disease of those parts exists.

VALUE OF DUODENAL DRAINAGE

This method has been found to be extremely valuable in the differential diagnosis of abdominal disease, the negative findings being particularly useful in ruling out biliary tract infection. The following cases illustrate its value, (1) in the case of negative findings; (2) in disease of the ducts; and (3) in disease of the gall bladder.

1. Negative Findings

A patient, age 30, complained of soreness in right upper abdomen. Had three or four attacks of abdominal cramps which would last 3 hours or more. Pain not associated with vomiting or other symptoms. He had typhoid fever 10 years ago. Has lost weight and strength. Has poor appetite. Eating food sometimes dulls the pain. The clinical diagnosis rested between cholecystitis and perinephritic abscess. Duodenal drainage was requested by surgeon. Duodenal drainage was done and the bile was reported to be not abnormal. Operation elected was for perinephritic abscess, which was found and drained. In this case, an exploratory laporotomy was not necessary to discover that the gall tract was not the seat of the trouble.

A girl of 18 complained of severe spasms of pain starting in right hypochondrium and radiating all over abdomen. She also complained of always feeling "bilious." She had typhoid fever at the age of 9 and catarrhal jaundice with similar pains as now, 4 months ago. Symptoms and physical examination pointed strongly to gall-bladder disease, though her age was against it (Starr, of Toronto, claims that gall-bladder disease does not belong to advanced years but can be traced back to the age of 13 in many cases). Clinical diagnosis, then, was cholecystitis with an associated cholelithiasis. Duodenal drainage was asked for to confirm the diagnosis but instead of doing that, a report was sent back to the contrary, the bile being reported negative for any evidence of infection of the biliary tract. At operation, the gall bladder was found to be of normal size and color, no stones present and it emptied in good time with very little digital pressure. The appendix, however, was found to be the cause of the disturbance. It was drawn up into the position of the gall bladder, the tip of the appendix being found at the costal margin.

A woman, age 45, complained of constant pain in right side just below costal margin, belching of gas, distress after eating. On physical examination, there was revealed a large, palpable mass in right hypochondrium. Clinical diagnosis was cholecystitis. Duodenal drainage was done and bile was reported negative for any inflammation of the biliary tract. At operation, mass in right hypochondrium was found to be a hard and fibrous tumor the size of a plum in the rectus muscle. Gall bladder was found to be not abnormal.

Numerous other cases diagnosed clinically as gall-bladder disease, in which a pre-operative duodenal drainage was allowed, were reported as having no evidence of gall-tract infection and the duodenal drainage report was confirmed at operation.

2. Disease of the Ducts

In a case of choledochitis, pus cells will appear in all three specimens, but most abundantly in the first; it appears in the gall-bladder and liver specimens because these must pass through the infected area and in so doing they pick up some of the inflammatory débris. Duct disease seldom occurs alone, being associated as a rule with gall-bladder disease or a liver disturbance. Julius J. Selman found an accompanying infection of the biliary tract in a number of cases of diabetes and chronic pancreatitis. Many patients return to the surgeon a few months after cholecystectomy complaining of much the same discomfort as before the operation, due to the fact that there was a co-existent cholangeitis with the cholecystitis which could not be remedied by surgical interference. Cholangeitis can be diagnosed and is amenable to treatment by means of duodenal intubation.

3. Disease of the Gall Bladder

In the diagnosis of gall-bladder disease, the efficacy of this method has been proved. With the aid of the duodenal tube, suspicious clinical gall-bladder cases have been either confirmed or disproved. I will illustrate a few cases that came to operation following duodenal drainage, in which the pre-operative diagnosis was corroborated.

A patient, age 60, complained of pain in both sides of upper abdomen radiating around to back at the same level. Attack commenced 3 weeks ago and seems to be getting worse each day. He has had recurring attacks of indigestion for about 10 years. Attacks usually come on about 10 to 30 minutes after eating, but may come on at any time during the day or night, for no known cause. Patient has no hunger pain, he ridicules the idea of eating to relieve the pain. He has no vomiting unless self induced; feels better after vomiting; no occult blood in vomitus. Bowels always constipated. He has had bleeding hæmorrhoids for past 10 years; no tarry stools. Appetite always good until present attack. Slight jaundice present, no previous jaundice. Clinical diagnosis: carcinoma of the stomach. Duodenal drainage was asked for before exploratory operation to throw some light on the jaundice noticed in the patient's scleræ.

Duodenal drainage. The bile, or rather the bile stained duodenal contents flowed immediately upon patient turning on his right side. After instillation of magnesium sulphate solution, duct bile flowed, a golden yellow, clear, amount 20 cubic centimeters. Microscopically this bile was negative, there being no deposit on centrifugalization. Culture showed bacillus coli. Gall-bladder bile, dark green, flocculent and turbid, amount 50 cubic centimeters, deposit in centrifuge tube was one-quarter inch of frank pus; microscopically sediment showed desquamated epithelial cells and very numerous pus cells; culture from this specimen showed bacillus coli and streptococcus hæmolyticus. The liver specimen was golden yellow and clear, showing few epithelial cells and a few odd pus cells by microscope and bacillus coli by culture.

At operation the stomach was thoroughly explored and no evidence of malignancy was found: the gall bladder was enlarged and distended with pus. The gall bladder was removed. The contents of the gall bladder appeared to be identical with that second specimen recovered with the duodenal tube before the operation, containing desquamated epithelial cells and numerous pus cells, while a culture from the gall bladder yielded streptococcus hæmolyticus.

Ten cases of cystic duct obstruction from stone, diagnosed as such with the duodenal tube, were later confirmed by operation. A description of one typical case follows.

A woman, age 45, felt perfectly well until 6 weeks before admission to hospital. Since then, she has had three attacks of severe pain starting in the pit of the stomach and working round to the right costal margin. Pains are sharp and "knifey." She has belching of gas and sour taste in her mouth for about 2 to 3 hours after eating. There is definite tenderness over gall bladder and also in right iliac fossa. Duodenal drainage showed the duct bile to be light lemon yellow and clear, amount 30 cubic centimeters. Microscopically there was a small amount of débris, no cellular structures, no pus cells, numerous organisms, and crystals of various shapes. After repeated stimulation with magnesium sulphate solution, color of bile did not change at all, just becoming a bit cloudy. No dark bile was ejected from the tube. On microscopic examination, this specimen showed a few epithelial cells, no inflammatory débris, crystals, and bacteria. Culture of both specimens showed staphylococci. On removing the duodenal tube, there seemed to be something holding it back; when tube was finally withdrawn, there was found a knot in it just 2 inches from the bulb. A report was sent to the surgeon that no gall-bladder bile had been recovered due to cystic duct obstruction, probably by a stone. At operation a few days later, gall-bladder walls were found to be thickened and the cavity packed full of stones. Cystic duct was completely obstructed; there was no bile in the gall bladder.

THE BILIARY TRACT AS A HIDDEN POCKET OF INFECTION

As a clinical aid in the detection of hidden foci of infection, in case of arthritis, neuritis, etc., the duodenal tube has proved to be of great assistance in locating the seat of the trouble in the biliary tract. Two interesting cases illustrating this follow:

A man, age 55, had typhoid fever 30 years ago, not severe, no complications. He had no other illness except measles in childhood. Twenty-five years ago, he had frequent attacks of tonsillitis. He is subject now to occasional attacks of backache, but has never been in bed for more than 2 days at one time. He has noticed a little stiffness across the elbow joints for the past 8 years, while 6 years ago his knee joints became slightly affected. About 2 months before his admission to the hospital he started with massage every second day and got progressively worse until he became bedridden and could not move any of his joints.

Examination revealed, height 5 feet 10 inches, weight 250 pounds (usual), all large joints swollen, smooth and shiny, swelling symmetrical, joints spindle-shaped. Heart very much enlarged, no endocarditis lesion present, had been on digitalis. X-ray showed evidence of gall-bladder pathology.

Duodenal drainage showed duct bile to be light green, turbid, and flowed until 50 cubic centimeters were collected before it changed to a dark green, flocculo-purulent bile, the gall-bladder bile, amount 120 cubic centimeters, then became light yellow and slightly cloudy, the bile from the liver. Small amount of pus cells were found in the first and third specimens, but the second specimen contained a large amount of inflammatory débris, numerous pus cells and numerous degenerated cellular structures and bacteria. Cultures of first specimen produced bacillus coli; second, bacillus coli, staphylococci and streptococci; and the third, bacillus coli. Duodenal

drainage showed the gall bladder to be a pocket of pus harboring bacillus coli, staphylococci, and streptococci.

As surgical interference was contra-indicated, patient was subjected to non-surgical drainage of the biliary tract; every second day and every third day was given an injection of autogenous vaccine made from the organisms in the gall-bladder bile. Patient's condition improved remarkably. After 2 months, drainage was reduced to twice a week for a period of 2 months, then once a week and once a month and now once in 3 months, just to keep a check on his condition. The bile cleared up of all its inflammatory débris and now appears to be normal in every respect. Today the patient walks to and from his office, climbs up and down the stairs without any difficulty, and outside of a little stiffness at times, claims that he feels fine.

Another interesting case of a hidden focus of infection was that in a young man suffering from retrobulbar neuritis. His teeth and tonsils were removed, sinuses in his head curetted without any improvement in his vision. Other examinations proved futile in locating the source of the trouble, and patient's vision was getting less each day. Duodenal drainage was asked for as a last resource. Duodenal contents contained great flakes of mucopurulent material. After magnesium sulphate solution was instilled, bile flowed a canary yellow, turbid and flaky. Microscopically, the sediment showed large amount of inflammatory débris, desquamated epithelial cells, numerous pus cells, bacteria. Bacteriologically, staphylococci and diplococci (gram-positive). This diagnostic drainage established the hidden focus of infection in the biliary tract, and patient's vision was increased 8 feet laterally a few days after this initial drainage. Duodenal drainage treatment was instituted at weekly intervals and the cellular content of the bile became clear and free from infection.

FURTHER USES OF THE DUODENAL TUBE IN DIAGNOSIS

Typhoid carriers. As a method of detecting typhoid carriers or determining whether a typhoid convalescent harbors the bacilli in his gall bladder or bile ducts, the tube has been found to be exceedingly helpful.

Parasites in the duodenum. The duodenal tube was used to good advantage to determine the presence of parasites or their ova in the duodenum or the biliary tract. It was by this method that Professor William Boyd, of the University of Manitoba, Pathological Department, was able to demonstrate the lamblia intestinalis, isolated from the duodenum of a typhoid convalescent. In one other case outside of the hospital, I was successful in discovering the lamblia in bile recovered by means of the tube.

Pancreatic ferments. The presence or absence of pancreatic ferments in the duodenal contents can be readily demonstrated with the duodenal tube and the use of Einhorn tubes. This study was not entered into in this work.

THERAPEUTIC USE OF DUODENAL TUBE

Many cases of clinical gall-bladder trouble have been relieved and the symptoms entirely alleviated by means of duodenal drainage and lavage. Such conditions as biliary stasis, atonic gall bladders that cannot empty themselves, the indeterminate chronic biliousness with severe headache, etc., have responded most satisfactorily to this treatment. The early stages of catarrh and infection of the biliary tract are most amenable to this treatment. Few cases have had only one treatment and have had no recurrence of their original trouble (18 months); others have a treatment at periodic intervals of 8 or 10 weeks, and in this way are relieved completely of their bilious attacks. The tube has also proved its great value in the treatment of hidden foci of infection located in the biliary system.

CONCLUSION

In my investigation five hundred cases have been studied. I feel satisfied to report that duodenal drainage is a helpful clinical method in the diagnosis and treatment of early diseases of the biliary system.

The whole procedure can be carried out in 1½ hours (average) and the patient does not suffer any inconvenience or discomfort; there are no after effects and the patient is free to get about and attend to his duties after the treatment.

Cases of suspected gall-bladder lesions that have come to operation have had the preoperative duodenal drainage diagnosis definitely confirmed. It will not be long before this method will be recognized in hospital and private practice as a necessary measure in the differential diagnosis of abdominal disease.

It presents an important means of determining the presence of parasites and their ova or focal infection of the biliary tract, conditions which may be of the greatest diagnostic

and therapeutic value in obscure conditions, such as arthritis, neuritis, etc.

Therapeutically, the method has proved to be extremely valuable in the early stages of catarrh and infection of the biliary tract, biliary stasis, chronic biliousness, and severe migraine. The duodenal tube cannot, by any manner or means, supplant surgery, where gross pathological lesions exist, such as cholelithiasis, empyema of the gall bladder with cystic duct obstruction or gangrene of the gall bladder, but where surgical interference is contra-indicated, because of a heart or kidney complication, the tube offers an alternative which in not a few cases affords much relief. In cholecystectomized patients who still complain of trouble in the right hypochondrium, the tube has been very useful in clearing up the stasis and infection, which could not be treated surgically.

I wish to acknowledge my thanks to the Hudson's Bay Company Research Fellowship Committee, of the University of Manitoba, for making this investigation possible; my indebtedness to the staff physicians and surgeons of the Winnipeg General Hospital for permitting me to use their material; and my appreciation to Dr. William Boyd for his kind assistance to me throughout.

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ACTINOMYCOSIS OF THE HEAD AND NECK

A Report of 107 Cases[1]

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ACTINOMYCOSIS of the head and neck is probably the most commonly overlooked pathological condition occurring in this region, as has been borne out by our experience in the Clinic. During the last 10 years, from 1913 to 1922, inclusive, 157 patients with actinomycosis have been examined at the Mayo Clinic. In 107 of these (68.1 per cent), the disease involved the head and neck; but in only 7 of this group were the patients receiving treatment for actinomycosis at the time of their examination. Some of the patients, however, had not consulted a physician. The recognition of actinomycosis of the head and neck in the Clinic has gradually increased from 2 cases in 1913 to 20 in 1922. During the last 3 years, 6 patients with primary actinomycosis of the tongue, and 2 with actinomycosis of the nasopharynx have been examined; we had not previously recognized the disease in these regions. Ninety-eight of the 107 patients were males. The age incidence was as shown in Table I.

The infection, as has been noted, is much more common in males than in females. The disease may appear at any period, from early childhood to old age. Our youngest patient was 9 years of age, and the oldest, 66. As is shown in Table I, the majority of patients were in early adult life, and almost 70 per cent of them were between the ages of 21 and 50 years. The activity of the disease bears no relation to the age of the patient.

LOCATION

The statistics of various authors differ as to the comparative incidence of involvement of the various regions, although all agree that the cervicofacial group makes up the majority. Von Baraçz, in 1903, reported 60 cases, 86 per cent of which involved the head and neck. In McKenty's series of 37 cases, 51 per cent are in the cervicofacial group. Our series of 107 cases comprises 68.1 per cent of the total of 157 cases examined at the Clinic. The primary site of the infection is shown in Figures 1 and 2, but the entire area infected is not always indicated, as often many areas were involved in the same patient. It is of interest that we have observed 6 cases of actinomycosis of the tongue in the last 3 years, and that only 35 cases were found recorded in the literature up to 1922. A more careful study of lesions of the tongue will probably disclose a larger series.

METHOD OF INFECTION

A consideration of the origin and mode of infection of actinomycosis in man has formed the basis for a great deal of investigation. It has been generally believed that the most common means of infection is by direct contagion from the lower animals. In taking the history of a patient suspected of having actinomycosis, we always inquire regarding the existence of lumpy jaw in cattle in the neighborhood. The presence of this condition probably indicates that the organisms are abundant on the vegetation of the locality, rather than that diseased animals are the primary cause of the infection in man. Transmission of the infection from the lower animals to man has been questioned. Leith denies this possibility, and it seems that this method of infection is less common, if it does exist, than was formerly believed. The 2 cases reported by Ochsner, so often cited as proof of direct infection, would seem to be little more than suggestive. Data with regard to 89 of the 107 patients in our series were obtained by means of questionnaires, and the question with regard to exposure to animals infected with actinomycosis was answered by 80. Of this number, 45 (56.1 per cent) had not, to their knowledge, come in contact with the disease in animals. The remaining 35 patients (43.7 per cent) had been more or

[1] Read before the Pacific Northwest Medical Association, Seattle, June 19–21, 1923.

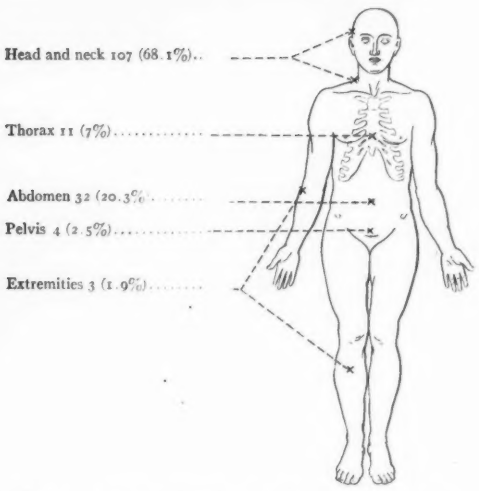

Fig. 1. Primary location of the disease in 157 cases.

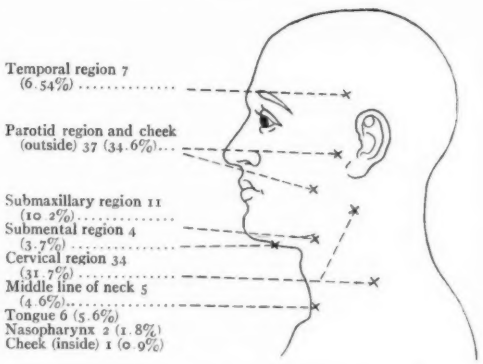
Temporal region 7 (6.54%)
Parotid region and cheek (outside) 37 (34.6%)
Submaxillary region 11 (10.2%)
Submental region 4 (3.7%)
Cervical region 34 (31.7%)
Middle line of neck 5 (4.6%)
Tongue 6 (5.6%)
Nasopharynx 2 (1.8%)
Cheek (inside) 1 (0.9%)

Fig. 2. Primary location of the disease in head and neck, in 107 cases.

less closely associated with the disease in animals previous to the onset of their symptoms. In all but 7 of these, the time that had elapsed from the exposure of which they were cognizant and the onset of the symptoms varied from 6 months to 25 years, an average of 5⅙ years. These 7 patients said that there had been lumpy jaw among their own cattle, or in the neighborhood, within 3 months of the onset of their complaint. A few of them had treated the lesions of the infected animals. Other facts, however, such as the presence of dental caries, picking decayed teeth with straws, or chewing bits of straw or grass were elicited in the history; thus, the probability of direct infection from cattle, even in this group of cases, is questionable. One of our patients with actinomycosis of the tongue had owned a cow with lumpy jaw 16 years before, but his symptoms were of only 6 weeks' duration. The nodule on his tongue, which was about 2 centimeters in diameter, had grown to this size from 0.5 centimeter in 3 or 4 weeks. Microscopic examination following the removal of the nodule revealed a foreign body within it, apparently a splinter of wood or a grain beard, the tip of which was surrounded by actinomyces. According to Harms, this finding has been made previously in 5 cases of primary actinomycosis of the tongue in man (Schortau, Fischer, Jurinka, von Baraçz [two cases]). It has been demonstrated a number of times in other tissues of the body, namely, in the mucous membrane of the mouth, tonsils, pharynx, lungs, intestines and external auditory canal. Bostroem, by studying serial sections of actino-

TABLE I.—AGE INCIDENCE

Age	Cases	Per cent
1 to 10 years	2	1.8
11 to 20 years	13	12.2
21 to 30 years	26	24.5
31 to 40 years	20	18.8
41 to 50 years	27	25.4
51 to 60 years	15	14.1
61 to 70 years	4	3.7
Total	107	

TABLE II.—OCCUPATION

	Patients	Per cent
Farmer	78	73.6
Laborer	9	7.5
Student	3	2.8
Clerk	2	1.8
Oil station manager	1	1.0
Meat cutter	1	1.0
Bookkeeper	1	1.0
Barber	1	1.0
Merchant	1	1.0
Stenographer	1	1.0
Tailor	1	1.0
Machinist	1	1.0
Miner	1	1.0
Cook	1	1.0
Locomotive engineer	1	1.0
Contractor	1	1.0
Chiropractor	1	1.0
Judge	1	1.0
Lumberman	1	1.0
Total	107	

mycotic lesions of the tongue in cattle, was able to demonstrate such foreign bodies in nearly all recent cases. In 5 of our cases there was a definite history of a foreign body. One patient said that he had not seen an animal with the disease for 25 years, but that 2 weeks before the onset of his trouble, he had gotten a barley beard in the floor of his mouth. Pain and soreness in this region had been followed by a mass in the submaxillary region. One patient thought he had had a rye beard in his throat, as he had a sharp, pricking sensation on one side of his throat; this was followed by a painful swelling of his neck a few days later. One patient had noticed a stinging sensation in his throat, after eating wheat, and a few days later, developed dysphagia, and a mass appeared on the side of his neck. One patient got a wheat beard in the right side of his throat, and 3 days later developed pain and swelling in the right submaxillary, cheek, and temporal regions. One patient had pain and dysphagia after injuring his tongue with a tobacco stem. In all of these cases the disease developed subsequently in the region that had been traumatized. This would seem to indicate a direct cause of the infection. Wright believes that such a foreign body probably does not introduce the infection, but merely creates an opening, permitting organisms normally present in the mouth to gain entrance into the tissues. It would seem that, if this were true, the organisms would be found entirely enveloping the foreign body, rather than surrounding the tip of it alone, as was noticed in our case. Lord has shown that these organisms occur in carious teeth and tonsillar crypts of persons who have no demonstrable actinomycosis, so that it is probably a rather

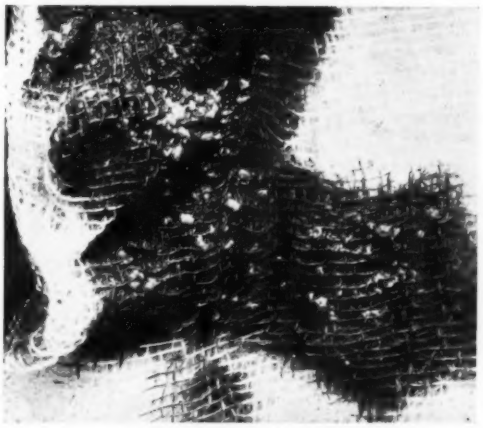

Fig. 3. (Case A346271.) Photograph of sulphur granules on a piece of gauze.

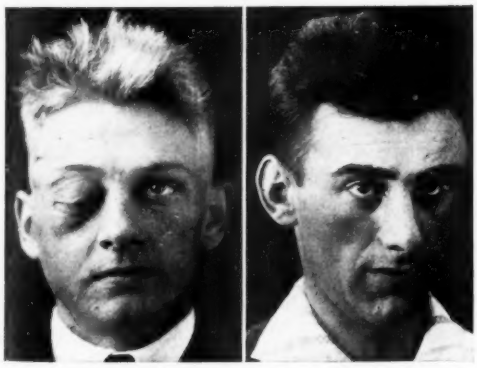

Fig. 4. (Case A325360.) Actinomycosis of the orbit, secondary to temporal region. Note the scarring in the temporal region and the exophthalmos of the right eye.

Fig. 5. (Case A203162.) Actinomycosis of the left temporal region.

Fig. 6. (Case A118952.) Actinomycosis of the nasopharynx, with involvement of the central nervous system. A hard mass was present in the left nasopharynx, with bilateral choked discs; the right 2 diopters, the left 1. The sixth nerve on the right was paralyzed. The symptoms were of 6 months' duration. Two months after the first examination a sinus appeared at the left outer canthus from which sulphur granules were obtained.

Fig. 7. (Case A359933.) Primary actinomycosis of the nasopharynx, simulating a malignant tumor. A hard mass, of 2 months' duration, was present in the left nasopharynx, bulging to the middle line. There was no external swelling. The tumor was clinically malignant. Two months later the cheek became involved secondarily, as shown in the picture.

Fig. 8 (at left). (Case A411342.) Actinomycosis of the mastoid region. Note the sulphur granules in the discharge.

Fig. 9. (Case A374014.) Primary actinomycosis of the tongue, of the diffuse, hard type, involving the floor of the mouth; 2½ months' duration. Previous diagnosis of cancer, clinically.

common inhabitant of the normal mouth. The infection is not infrequently seen following dental procedures. In one of our cases it developed while the patient was being treated for pyorrhœa, in 6 it immediately followed the extraction of teeth, and in one, it followed the removal of tonsils. This patient had been attending an eastern girls' school. She had never been on a farm and had been in the country very little. One case of primary actinomycosis of the tongue developed immediately after biting the tongue. Four patients gave a history of an acute sore throat directly preceding the onset of their infection,

TABLE III.—GEOGRAPHIC DISTRIBUTION OF PATIENTS AT TIME OF INFECTION

Minnesota	18
South Dakota	16
Canada	15
Iowa	10
Montana	8
North Dakota	7
Wisconsin	5
Missouri	5
Indiana	4
Illinois	4
Nebraska	3
Ohio	3
Washington	2
Michigan	1
Kansas	1
Oregon	1
Oklahoma	1
Georgia	1
Colorado	1
Wyoming	1
Total	107

Fig. 10 (at left). (Case A416985.) Primary actinomycosis of the tongue. The nodule on the left margin of the tongue is of 1 month's duration.

Fig. 11. (Case A416985.) Low power photomicrograph showing a foreign body with actinomyces about the tip, which was found in the excised nodule from the tongue.

although this may have been the first manifestation of the disease.

In none of our cases was there evidence of direct transmission from one person to another. McKenty and von Baraçz have each reported one case which strongly suggests such transmission. Infection from milk or meat of diseased animals seems hardly probable, although one of our patients with primary actinomycosis of the tongue was a meat cutter, and Madyl reports a case of an inspector, who, while inspecting meat, frequently moistened his thumb with his tongue. He noticed a stinging pain on the area of the tongue where he had applied his thumb, and a few days later developed actinomycosis in this region. This meat, of course, was not cooked.

CLINICAL HISTORY AND FINDINGS

The clinical history of patients with actinomycosis of the head and neck depends on the virulence of the infection and the amount of secondary infection. The condition may occur as an acute phlegmon and the symptoms not differ from this. The most common symptoms are a stiffness in the region involved, pain, and swelling. The jaw may begin to tighten and become completely ankylosed. Pain in these cases is sometimes severe and throbbing, or it may be entirely absent until the mass breaks down. In certain cases dysphagia is an early symptom, especially if the base of the tongue or anterior cervical region is involved. In one of our

cases the dyspnœa was marked, because of involvement of the hypopharynx and epiglottis. Sore throat, stiffness of the neck, and earache are occasional symptoms. All types are seen, from a small recurring superficial abscess to extensive suppurating areas with multiple openings involving almost the entire half of the head and neck. The activity of the process varies from a slow, indolent condition which develops in the course of months or years, to a fulminating one of a few weeks' duration. The characteristic picture of an indurated mass which later breaks down, developing multiple superficial abscesses, is probably the most common. The swelling may be a small nodule below the skin or mucous membrane, or may be a fixed, diffuse, hard mass 12.5 or 15 centimeters in diameter. Breaking down of the involved area may occur in a few days, or the hardness may persist for months. In the cervical region the abscesses are usually elongated, superficial and multiple, and the skin over them, which is folded in linear striations, has a soft, doughy consistency.

Fig. 12. (Case A150862.) Actinomycosis inside the right cheek, posteriorly, at the margin of the jaw, of 3 weeks' duration.

DIAGNOSIS

The diagnosis of actinomycosis must be based on the clinical picture, the finding of the sulphur granule, and the microscopic demonstration of the actinomyces (Fig. 3). If the disease is in the tongue, or if there is a great deal of secondary infection, a diagnosis of actinomycosis must depend on detailed study of the tissue removed for microscopic examination. In a group of cases presenting the classical symptoms and clinical picture, a diagnosis is simple. A large number of the cases, however, are recognized with much more difficulty, and it is often necessary to keep the patient under observation for a time to corroborate the clinical evidence. If a fresh pocket can be opened, the sulphur bodies usually are easily demonstrated, but if there is a great deal of secondary infection, it is sometimes very difficult to obtain one for microscopic examination.

TABLE IV.—DURATION OF SYMPTOMS BEFORE EXAMINATION

Time	Cases
1 to 2 weeks	4
2 to 4 weeks	4
1 to 2 months	29
2 to 4 months	27
4 to 6 months	10
6 to 8 months	9
8 to 10 months	5
10 to 12 months	7
1 to 2 years	4
2 to 3 years	4
Over 3 years	2
Indeterminate	2
Total	107

In 43 cases, 46.2 per cent of our series, a microscopic diagnosis was made within 2 days after the first examination. In 66 cases, 72 per cent of our series, it was made in 1 week, and in 72 cases, 77.4 per cent of our series, it was made within 2 weeks. In 21 cases the microscopic diagnosis was not made for a month to 6 weeks following the first examination, sometimes at a subsequent visit. Often treatment was instituted on the clinical evidence of actinomycosis, although this could not be corroborated microscopically. In 8 of our cases, in which a clinical diagnosis was made, we were not able to demonstrate the condition microscopically during the patient's stay at the Clinic.

The gross appearance of the granules is quite characteristic. As a rule, they are light

Fig. 13 (at left). (Case A405621.) Diffuse fulminating type of actinomycosis of the left side of the face and neck, of 3 months' duration, showing multiple sinuses.

Fig. 14. (Case A392156.) Actinomycosis outside of the left lower jaw. Classical location.

Fig. 15 (at left). (Case A367261.) Actinomycosis of the parotid region and lower jaw, a hard tumor of 1 year's duration, simulating sarcoma.

Fig. 16. (Case A299687.) Actinomycosis of the parotid and submaxillary regions. Note the new pockets forming in the parotid region.

yellow, and about 0.5 millimeter in diameter, although we have seen them in some of our cases whitish or dark gray. It is very essential that the physician who drains the phlegmon or explores the tumor should examine carefully for the sulphur granules and corroborate his diagnosis by microscopic examination. This will be much more satisfactory than simply saving pus from a drained phlegmon and referring it to the clinical pathologist for diagnosis. Sanford and Magath have recently discussed the laboratory diagnosis of this condition.

In Table V is a list of diagnoses which had been made in some of our cases, either before examination or at the Clinic before the true diagnosis was established.

Actinomycosis may secondarily involve any part of the head and neck, and must be distinguished from many types of tumor in this region. The hard, fixed mass over the temporal region, of 3 to 6 months' duration, may be sarcoma, or actinomycosis. The subacute, subperiosteal abscess over the mastoid region

Fig. 17 (at left). (Case A406422.) Actinomycosis of the cervical region simulating a branchial cyst sinus.

Fig. 18. (Case A406422.) Roentgenogram of patient in Figure 17. Bismuth which was injected into the sinus in the neck came out through the upper hole of the tonsil. The tonsil did not reveal actinomyces microscopically.

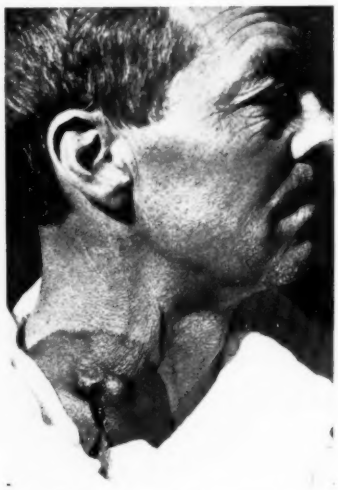

Fig. 19. (Case A406904.) Actinomycosis of the cervical region, simulating metastatic gland. A gland, showing clinical signs of malignancy, was removed from the anterior cervical region for diagnosis; it was reported inflammatory. Actinomyces were not looked for at that time. Later examination showed the condition to be actinomycosis. Sulphur bodies are shown in the discharge.

Fig. 20. (Case A357702.) Bilateral cervical actinomycosis of 10 months' duration, which was diagnosed tuberculous adenitis.

Fig. 21. (Case A354858.) Actinomycosis of both cervical regions and the back of the neck, of 1 year's duration. The diffuse hard masses were diagnosed malignant lymphoma.

and scalp may be a primary suppurative condition of the mastoid, or it may be actinomycosis. We have seen 2 patients with hard masses in the lateral wall of the nasopharynx, bulging to the middle line, with no other neoplasm of the head visible. These were clinically malignant, but both proved to be actinomycosis.

Actinomycosis of the tongue may simulate a deep seated cancer, an infected cyst, or chronic cellulitis. We have not seen actinomycosis of the jaw bone itself, but on account of the picture presented by the involvement of the soft tissues around the bone, forming a hard mass, it must be differentiated from a periosteal sarcoma.

A phlegmon, supposedly secondary to an abscessed tooth, may be actinomycosis. In the submaxillary and cervical regions, actinomycosis must be differentiated from a chronic phlegmon, tuberculous gland, malignant lymphoma, metastatic malignant glands, phlegmon, sinus from tooth or tonsillar infections, or an infected branchial sinus. Actinomycosis in the middle line of the neck has been diagnosed thyroglossal-duct sinus, cancer of the thyroid, and tuberculous thyroiditis, in three cases (Figs. 4 to 23).

TABLE V.—DIFFERENTIAL DIAGNOSIS

Retro-orbital tumor
Malignant mass in temporal region
Subperiosteal abscess of scalp and mastoid region
Nasopharyngeal tumor, malignant
Infected cyst of tongue
Cancer of tongue
Tumor of base of tongue, malignant (?)
Sarcoma of upper jaw and parotid region
Osteomyelitis of lower jaw
Chronic phlegmon of submaxillary region, secondary to extraction of teeth
Phlegmon of cheek, secondary to pyorrhœa treatment
Chronic phlegmon of cervical region, secondary to tonsillectomy
Bilateral cervical adenitis, secondary to "flu" (?); malignant (?)
Chronic indurated cellulitis of neck
Carcinoma of cervical region, recurring
Tuberculous adenitis
Bilateral malignant lymphoma of the neck
Thyroglossal duct sinus
Tuberculous thyroiditis
Cancer of thyroid

TABLE VI.—END RESULTS

Patients		107
Patients traced		93
Not included		8
Meningeal involvement at the time of examination	6	
Diagnosis only; no treatment	1	
Death from cancer which developed on actinomycotic scar	1	
		85

Condition of 85 Patients Traced	Patients	Per cent
Well 5 years or more	9	
3 to 4 years	2	
2 to 3 years	5	
1 year	11	
Less than 1 year	9	
Time not stated	24	
	60	70
Dead	7	8.2
Under treatment	18	21
	85	

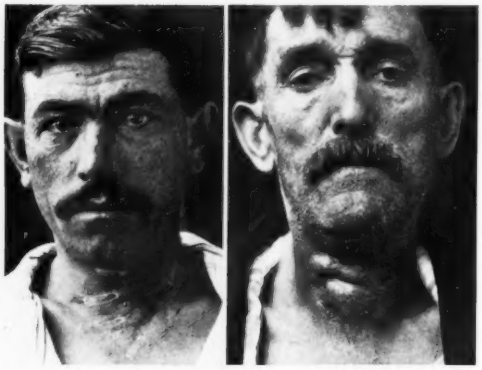

Fig. 22 (at left). (Case A360908.) Actinomycosis of the middle line of the neck, showing fixed mass in the region of the thyroid. The scars are of a previous operation for "cancer of the thyroid."

Fig. 23. (Case A409278.) Actinomycosis of the middle line of the neck, œdema of the pharynx and larynx, a hard, diffuse mass extending from the submental region to the manubrium, with fluctuant areas, secondary œdema of the hypopharynx and larynx, with some obstruction. Two months' duration.

With meningeal or chest involvement, additional differential problems are brought up. Moersch has reported the cases of actinomycosis of the central nervous system that have been seen at the Clinic.

TREATMENT

The most important factor in obtaining good results in the treatment of actinomycosis is an early diagnosis. In the early cases the patients all do well; we have not seen such patients become progressively worse during treatment. In advanced cases, however, with extensive involvement of the head, intracranial extension may develop, or in cases of extensive supraclavicular or cervical masses, the chest may become involved in spite of treatment. Treatment is empirical. The internal administration of copper sulphate has not proved markedly effective. Arsenic was formerly used, but its good effect was apparently due to its general systemic action. The iodides are almost specific. Mercuric chloride, phenol, tincture of iodine, and so forth, each has been injected directly into the masses, but each has been discarded. Roentgen-ray treatment is used; McKenty, however, believes that it is distinctly harmful.

TABLE VII.—DEATHS

Death probably due to meningeal involvement	2
Actinomycosis of temporal region and orbit	1
Death reported as due to anterior poliomyelitis and paralysis of respiratory system	1
Deaths probably due to involvement of the chest	3
Huge mass in cervical and supraclavicular regions; positive roentgenograms of chest, probably actinomycosis	1
Masses in bilateral, cervical, and supraclavicular regions, and in back of neck	2
No data regarding cause of death	2
	7 (8.2 per cent)

Recently radium has been used a great deal, and has proved very beneficial in causing a breaking down of the granulomatous masses and clearing up the induration. Surgery is a definite aid to medical treatment. The procedure we have found of most value is the opening up widely of all pockets, and packing them with iodoform gauze so that the entire area of the pocket is exposed to the air. The pockets are dressed daily, using iodoform gauze and swabbing the wound with iodine. Radium treatment is used in all cases and is repeated, as a rule, about once every 3 or 4 weeks. If the mass is hard and indurated, with no fluctuant areas or sinuses, radium is applied over the surface with 2 millimeters of lead screening, and an inch of wood distance, using from three thousand to six thousand millicurie hours in this way. This will often break down the masses and allow them to be drained. The radium also seems to block lymphatic drainage. Since we have used this treatment, none of our patients, except in the most advanced cases with masses in the supraclavicular region, has developed extension to the chest. We have also used saturated solution of potassium iodide, starting with 10 drops three times a day, and increasing it 1 or 2 drops a dose until 200 drops three times a day are being taken. If any evidence of iodism is noticed, the iodide is discontinued for a day or two, and then resumed at the same dose. After reaching 200 drops three times a day, the patient discontinues the treatment for a few days or a week, and then starts in

again at 10 drops. By this method we have cleared up the condition in practically all of our cases except the advanced ones, in which, on account of the proximity to the skull or the chest, the infection has extended to the meninges or the thorax.

CONCLUSIONS

The clinical picture of a rapidly growing, malignant tumor may be so closely simulated by actinomycosis that a clinical diagnosis of such a tumor should be guarded.

A tumor or gland of the head or neck which is clinically malignant, but does not prove so microscopically, is usually actinomycotic, and further study of the tissue may demonstrate this.

The finding of a sulphur granule on exploring a tumor, draining a phlegmon, or curetting a sinus of the head or neck, frequently clears up many indeterminate diagnoses.

A reduction in the mortality of the disease depends on its early recognition and the institution of proper treatment.

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A CLINICAL STUDY OF RADIUM THERAPY IN CARCINOMA OF THE RECTUM

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THE whole cancer situation has undoubtedly been vastly improved by the advent of radium. This dictum applies to the treatment of rectal cancer in particular, but at best the therapy in this field is still both difficult and often disappointing. From the radiologist's standpoint we encounter the same obstacles which hinder the surgeon, namely, the difficulties of approach to the seat of the disease and the late symptoms, often rendering early diagnosis impossible and bringing us cases too far advanced for any hope of cure and, indeed, too frequently with but little hope of palliation, not to mention, too, the frequent cases treated for hæmorrhoids with the loss of precious time while the disease is advancing. Therefore, as things are, if we can only measurably relieve some of the hopeless, comfortably prolong the lives of others, and cure any appreciable percentage of cases, we are realizing a therapeutic triumph. This in fact we are able to do with radium in proper dosage, accurately applied, with efficient applicators. As knowledge increases with experience and we understand better the action of radium on the tissues and are able to learn why some tissues respond while others remain resistant, and as improvements are made in applicators and methods, it is also to be expected that the measure of relief afforded will be greater and the percentage of cures perceptibly higher.

METHODS OF APPLICATION

Before reviewing the cases we have handled, we desire to describe first of all the methods of application of radium emanation in use in the Kelly Hospital in the treatment of rectal carcinoma. There are available here, as in other regions of the body, three procedures, named in the order of their therapeutic value: (1) implantation of bare emanation needle points into the disease; (2) direct application of the emanation to the diseased area; (3) external or so-called deep radiation, with massive doses at a distance and fired into the diseased area from several directions.

1. The technique of the implantation of needle points carrying the emanation is that described by Neill in his article entitled, "Further Treatment of Bladder Tumors," in the *American Journal of Surgery*, December, 1920. The tiny glass capillary capsules carrying from 0.5 millicurie to 1.5 millicuries are inserted or, as we say, "threaded" into the end of a long needle, shown at *E*, Figure 1. With the patient in the knee chest posture, a Kelly proctoscope is inserted, the diseased area exposed and cleansed, and the needle then plunged directly into the growth, preferably near its periphery, under the control of sight (Fig. 2); the glass point is then thrust out of the end of the needle into the tumor, where it remains indefinitely if it does not come away with a separating slough. The number of needle points thus inserted in an individual case naturally depends upon the size and extent of the growth and its get-at-ability. The rule is that one millicurie of emanation will destroy one cubic centimeter of tumor tissue. While this method affords the most direct and intensive application and consequently the most efficient and economical dosage, it is most effective in the lower, more accessible parts.

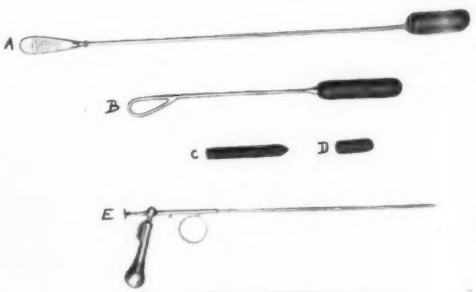

Fig. 1. Radium needle carrier, parts and assembled.

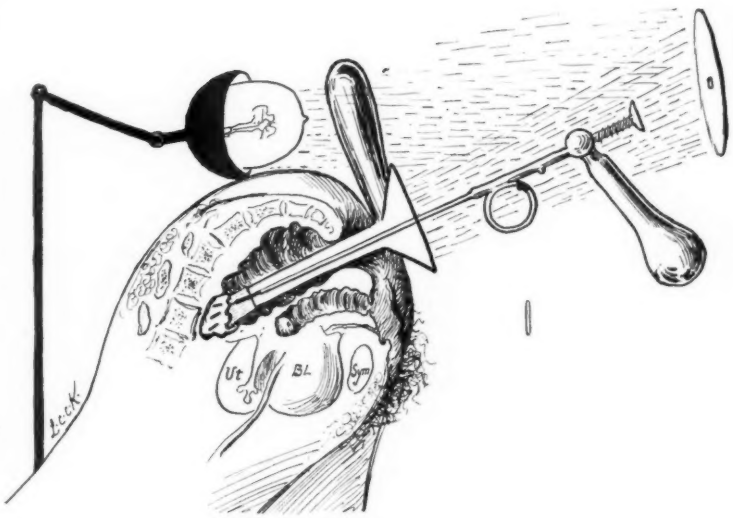

Fig. 2.

Fig. 3.

Fig. 2. Diagram illustrating the implantation of bare emanation needle points into the diseased tissue. The patient is represented in the knee chest posture with a Kelly proctoscope in the rectum. The needle carrying the emanation point is passed through the proctoscope into the growth. In the illustration three points are shown implanted. One is pictured in actual size at the right of the sketch.

Fig. 3. Radium applicator.

2. For the direct application through the rectum to the surface of the tumor, there are various applicators devised to fit the varying contours of the growth. For simple flat tumors a cloth applicator (*A*, Fig. 3) is best. The base of the applicator is made up of rather heavy gauze with several little pockets, each slightly larger than a radium tube of brass (*B*, Fig. 3), measuring 1 centimeter in length and 0.5 centimeter in diameter, which is pushed into it. The tubes are kept in the pockets by means of a purse string tied about the mouth. For filtration, various thicknesses of felt are sewed onto this gauze carrier. The size and shape of this applicator and the number of tubes contained will vary with the size and shape of the lesion; in each case, therefore, this is determined at the first examination and a drawing made to serve as a pattern. The application is effected through the Kelly cylindrical proctoscope with the patient in the knee chest posture. When the disease is extensive or high up or when for any reason the treatment is likely to be distressing, the contact with the radium can be secured with the patient in the dorsal posture. Sometimes we apply the radium after putting the patient under an anæsthetic. After setting the applicator in position, the adjacent normal mucosa is packed off and protected by lead filters or plain gauze or both. The filters, an important part of the technique, are small oval pieces of lead 4 by 2 by 0.5 centimeters, wrapped with gauze, to absorb the secondary rays and to render the filter more manageable (*C*, Fig. 3). (These applicators were first described by Burnam in the *American Journal of Roentgenology*, November, 1922, p. 769.) Where the growth is annular, a hard rubber finger-like applicator with a brass handle is excellent (*B*, *C* and *D*, Fig. 1). The thickness of the hard rubber may be 2 (*C* and *D*) to 4 millimeters (*B*). The applicator is cylindrical with a hollow center in which three or four radium tubes are bedded; when fewer tubes are wanted, the loaded ones are set in the distal end and blanks fill out the space. In this manner the radium is distributed all along a cylindrical growth. The charged applicator is inserted either through

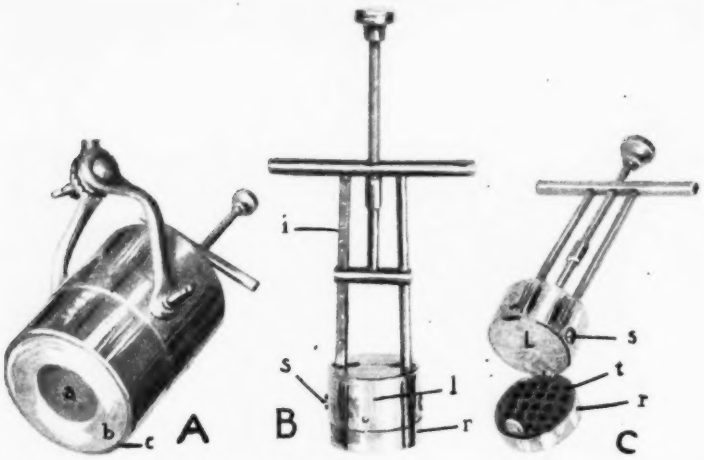

Fig. 4. A, Ward's lead cylinder used in giving heavy external radiation. The α-rays coming from the emanation tubes in the carrier within the cylinder emerge through the 2 inch portal, *a* and pass to the patient. *b*, One inch lead wall of the cylinder. *c*, The supporting collar of ⅛ inch brass. The cylinder is suspended over the patient by means of a car and crane and permits of focusing at any angle, allowing cross-firing of the tumor without irritating the skin.

B. Radium emanation carrier made to fit the inside of the cylinder. *r*, Box containing tubes of emanation; *l*, 1 inch of lead above box used to protect operator's hands; *i*, 1 inch scale on handle to indicate distance of emanation from skin of patient; *s*, brass stubs. These are forced against inner wall of cylinder by moving the central brass rod in handle upward, thus fixing the emanation at the desired distance from the skin.

C. Same as B but opened to show holes, *t*, for radium tubes.

the proctoscope, as above, with the patient in the knee chest or lateral posture, or preferably or more simply, with the patient in the lateral position, guiding the applicator with one finger in the rectum and omitting the speculum. The apparatus is held in place by fixing the brass handle to sand bags with strips of adhesive plaster. One or 2 gram hours is the dose commonly given.

3. For a heavy external application, thick lead cylinders with 2 or 3 inch portals are used (Fig. 4). The heavy lead prevents overlapping treatments and renders it possible to treat several areas, cross-firing the growth, at the same time avoiding injury to the skin. In this way as much as 1 or 1½ gram hours can be delivered to the heart of the disease without more than a slight erythema, while extensions of the growth or metastases in the glands are also reached. The areas of election are three or four over the sacrum and coccyx, one through the perineum, and (especially where the pelvic growth is extensive) the groins and suprapubic regions. If four areas are elected and the distance from the skin fixed at 3 inches, with a dosage of 10 gram hours over each area, we thus give a total of 40 gram hours, a substantial and effective dosage. This form of treatment with the internal radiations and implantations, make it possible greatly to reduce large tumors of the rectum and to relieve for years as well as to cure a definite percentage of cases. Using these methods we see some rectal irritation but no serious reaction. We have noted rectal irritation in 13 cases, in but 2 has there been any bladder disturbance. In 10 cases there has been post-radiative scarring or stricturing.

REVIEW OF CASES

In the series before us we include every patient who has entered our hospital with a diagnosis of primary carcinoma of the rectum and treated with radium either alone or in

combination with operation, from December 10, 1911, to January 24, 1922,—covering 10 years plus. These patients have been followed up to date as far as possible—thus far 11 years and 5 months. We include all treated, whether hopeless, far advanced or fairly early. But one had symptoms under 6 weeks, and she, though benefited, refused a second treatment after 170 millicurie hours given internally. The following table shows the condition of the patients on admission. The total number treated is 230; in 30, sufficient data as to the effect of radium are wanting, and this number has been deducted from the total, leaving 200 in the series to be considered.

TABLE I

Total treated		230
Number not reported		30
Total in the present series		200
	Cases	Per Cent
Apparently hopeless from radium or any other viewpoint	19	9.5
Metastases and involved glands	20	10
Operable	12	6
Inoperable	145	72.5
Previous operations on the disease	43	21.5
Previous colostomies done (hopeless and inoperable groups in part)	16	8
Previous exploratory operations without removal (several of the colostomies)	7	3.5
Recurrent after former operation	33	16.5
Prophylactic treatment after operation	10	5
Previous radium treatments in	10	5
Previous X-ray treatments in	9	4.5

Only 6 per cent were considered as at all operable, the rest were inoperable, and as a rule applied for radium as a last resort.[1] Out of this conglomerate group 11 per cent were cured, 62 per cent benefited to a lesser or greater degree and 27 per cent were left unbenefited. In order to analyze our results and to obviate the confusion of considering such a heterogeneity of cases as we list above, let us divide them into four groups: namely, (1) the utterly hopeless cases (9.5 per cent); (2) those not benefited by treatment; (3) those benefited; (4) those apparently cured.

Hopeless cases. In dealing with an apparently hopeless case, all one can expect is to give some measure of relief; if this is accomplished, the effort is fully justified. This goal has been reached in over one-half of our hopeless cases. Out of the 19 under consideration, 12 were improved (63.1 per cent) and 7 (36.9 per cent) unimproved. By improved we mean that some or all of their symptoms were alleviated and they were often made comfortable up to the exitus. We look back with genuine pleasure upon these concrete services to this wretched despairing class. Our improved hopeless patients lived from 2 months to over 3 years. Of those not benefited, 3, or a little less than 50 per cent, were inadequately treated for various reasons. Let us consider a typical case:

Mr. M. A. P. (5476), age 44, entered the hospital September 20, 1919, with a history of bleeding, pain, and loss of weight for over 3 months. In July, 1919, a colostomy had been done for obstruction. An extensive growth was found and a note made that there were probably deep abdominal metastases. A course of five treatments was given, totaling 56.9 gram hours, externally, distributed over the sacrum and abdomen. Following these treatments there was a decrease in the amount of bleeding, pain was relieved, the discharge lessened, and he lived for a year, dying finally with metastases in the liver.

Cases not benefited by radium. This class numbers 54, or 27 per cent. The following summary will show the condition of such patients when first seen:

TABLE II

Hopeless class	7
Constitutional symptoms marked in	11
Postoperative—no immediate recurrence (prophylactic radiation)	1
Tumor mass fixed	22
Not fixed	3
Degree of fixation not stated	29

This list shows that there were really only 4 cases (three not fixed and one radiated prophylactically) which were disappointing in the outcome. Why these 54 cases failed to respond we cannot say as some of them received as much radiation as others who were greatly relieved or even cured. The unsatisfactory answer must be for the present that they were not equally "radio-sensitive." In consulting Tables IV, V and VI one will find the type of treatment given and the percentage of non-improvement for each type of treatment.

[1] It will be noted that in addition to the inoperable group, there are some who came to us with recurrences and others who came for prophylactic radiation. The operable group does not include those who were operated upon previous to admission.

In 6 cases there has been a definite increase in the growth, which might be attributable to the so-called radium stimulation or to the marked insensitiveness of the tumor to radium. One of these cases received a very heavy dosage, the others were mild but should have shown some improvement.

Cases benefited. In this class we place all those whose symptoms were alleviated or entirely relieved, including the hopeless class and the extensive cases who were helped in any definite degree. The entire number benefited is 124, or 62 per cent of the total. A summary of the improvement in the individual symptoms will be of interest.

TABLE III

	Improved	Not improved	Not reported
General improvement	89	5	30
Mucus discharges	65	8	51
Noted locally	104	7	13
Weight	49	7	68
Cessation of bleeding	68	1	55
Lessened pain	102	5	17
Prevention of colostomy by relief of obstruction	8	..	..
Constipation	25	1	98

In Table III, in the third column, marked "Not reported," are placed those cases in which no definite statement was found in the history concerning that particular symptom, or perhaps the patient did not complain of the given symptom. In some of the cases the local improvement was even to the extent of complete disappearance of the local tumor, while metastasis developed. This shows clearly the need of getting the patient early before metastases. We have seen, however, temporary improvement where metastases have been local or to neighboring glands.

We would call attention to the fact, as shown by Table III, that in 8 cases the obstruction was sufficiently relieved to obviate an impending colostomy. Nine of these 124 improved cases had been found inoperable at previous exploratory operation.

Before considering the "cured cases," it might be well to consider the values of the various types of treatment, as well as the relationship of these types to combination treatment, that is to say, radium plus operation or radium plus colostomy. We have prepared three tables for this purpose. In each table we first cite the well cases, then the improved ones according to the length of improvement, then those not improved. The number of hopeless and extensive cases of each group is mentioned merely for the sake of comparison. The upper half of Table IV is a classification showing the values of each type of treatment with numbers and percentage.

Of the cases which were treated with radium alone, where there were 6.3 per cent hopeless and 61.7 per cent extensive, there is an actual cure of 8.5 per cent. These will be considered more carefully under the "cured cases." The palliation in this group is 65.9 per cent, 37 per cent of which (24.2 per cent of this group) lived over 18 months. The combination radium treatment, that is to say given externally and internally, gave the highest percentage (70.3 per cent) of palliation and apparent cures (11.2 per cent). The cures with the external treatment were about the same (11.1 per cent), but the internal alone were lower (5.8 per cent). External and internal gave about the same amount of palliation. There are hardly enough cases treated with needles alone or needles plus internal application to justify drawing conclusions as to those methods. It is interesting to note that even though there are no well cases in the group treated by a combination of all three methods, there is only one case not improved. The number here is also too small for conclusions, but of the 9 so treated, all but one were helped. One has remained well a year and a half after one implantation of 14 needle points of 1.5 millicuries each.

Of the four cases in this group pronounced operable on admission, two are well and two were benefited. (Two of these four cases refused operation, one preferred radium and there are no notes why the other was given radium instead of operation.) In other words, of the operable cases treated with radium *alone*, 50 per cent are well and 50 per cent benefited.

In considering the radium plus operation group, we find a higher percentage of well patients (17.5 per cent) than in those treated with radium alone; we find, too, that the re-

TABLE IV.—GROUP I—PATIENTS TREATED WITH RADIUM ALONE

Arrangement according to method of treatment	External		Internal		Needles		All three		Ext. and needles		Ext. and internal		Int. and needles	
	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent
Improved	16	59.2	10	58.9	1	....	8	....	3	....	19	70.3	5	....
Not improved	8	29.7	6	35.3	1	....	1	....	3	....	5	18.5	0	....
Well	3	11.1	1	5.8	1	....	0	....	0	....	3	11.2	0	....
Total patients	27	....	17	....	3	....	9	....	6	....	27	....	5	....

SUMMARY

Duration	No. of patients	Percentage of patients in this group	Duration	No. of patients	Percentage of patients in this group
Well	8	8.5	Total patients in this group	94	
Improved 6 months	19		Apparently hopeless from radium or any other viewpoint	6	6.3
1 year	20		Extensive	31	61.7
18 months	12		Operable	4	4.2
2 years	5		Inoperable	90	95.8
Over 2 years	6				
Total improved	62	65.9			
Not improved	24	25.6			

TABLE V.—GROUP II—PATIENTS TREATED BY RADIUM PLUS OPERATION

Arrangement according to method of treatment	External		Internal		Needles		All three		Ext. and needles		Ext. and internal		Int. and needles	
	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent
Improved	11	42.4	2	....	1	....	2	....	4	....	8	47.1	1	....
Not improved	6	23	2	....	0	....	0	....	2	....	8	47.1	0	....
Well	9	34.6	0	....	0	....	1	....	0	....	1	5.8	0	....
Total patients	26	....	4	....	1	....	3	....	6	....	17	....	1	....

SUMMARY

Duration	No. of patients	Percentage of patients in this group	Duration	No. of patients	Percentage of patients in this group
Well	11	17.5	Total patients in this group	58	
Improved 6 months	7		Apparently hopeless from radium or any other viewpoint	5	8.4
1 year	5		Extensive	16	27.5
18 months	4		Recurrent after operation elsewhere	33	57.9
2 years	5				
Over 2 years	8				
Total improved	29	50.5			
Not improved	18	32			

sults of the various methods of treatment were similar. An improvement was noted in 50.5 per cent of the cases and about 60 per cent of these lived 18 months or longer. These were naturally much earlier cases, and some had been operated upon before coming to us, but when admitted 8.6 per cent were recurrent and hopeless and 27.5 per cent were recurrent and extensive. The two classes which afford sufficient data for comparison are those treated (1) externally and (2) externally and internally combined. In the first there was a 42.4 per cent palliation and a 34.6 per cent cure. Two of these cured cases came with a recurrence, 5 for prophylactic treatment, and the remaining 4 had operation after admission. The second class (2) yielded but one well patient but a palliation of 47.1 per cent; here,

TABLE VI.—GROUP III—PATIENTS TREATED BY RADIUM—COLOSTOMY

Arrangement according to method of treatment	External		Internal		Needles		All three		Ext. and needles		Ext. and internal		Int. and needles	
	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent	Pts.	Per cent
Improved	7	46.7	4	....	1	....	4	....	1	....	14	82.6	2	....
Not improved	7	46.7	1	....	0	....	1	....	1	....	2	11.6	0	....
Well	1	6.6	1	....	0	....	0	....	0	....	1	5.8	0	....
Total patients	15	....	6	....	1	....	5	....	2	....	17	....	2	....

SUMMARY

Duration	No. of patients	Percentage of patients in this group
Well	3	6.3
Improved 6 months	9	
1 year	9	
18 months	9	
2 years	3	
Over 2 years	3	
Total improved	33	68.7
Not improved	12	25

Duration	No. of patients	Percentage of patients in this group
Total patients in this group	48	
Apparently hopeless from radium or any other viewpoint	7	14.8
Extensive	19	40.4

	Well	Improved	Not improve
Colostomy prior to radiation	2	16	6
Colostomy following radiation (for obstruction)	1	17	6

however, was a larger number of unbenefited patients (47.1 per cent). It is interesting to note the high percentage of palliation in the other classes of this group, in some of which the tumor was radiated down to an operable size and then removed.

Thirty-three patients in this group were sent to us after recurrence from former operation. Of these, 2 (9.1 per cent) are well; 19 (57.5 per cent) were benefited by the radium treatment and 12 (33.4 per cent) were not benefited by radiation. By careful study we found that these results have no relationship to the time of the recurrence, the type of operation or the fixation of the recurrent tumor.

The radium-colostomy group did not give such good results as to well patients; it did give the highest percentage of palliation (68.7 per cent), with the lowest percentage of non-improvement (25 per cent). Of the 68.7 per cent palliation, 45.5 per cent lived 18 months or longer. Here, too, there were hopeless (14.8 per cent) and extensive (40.4 per cent) cases. In spite of this, however, 6.3 per cent are well. It made little difference whether colostomy was done prior to radiation or after obstruction seemed evident. External radiation alone yielded equal palliation and non-improvement in its class with a 6.6 per cent cure. Combination of internal and external treatment, however, brought an 82.6 per cent palliation, although only 5.8 per cent (one case) was well. In this case colostomy was done 10 days after admission because the growth did not diminish. All treatments were given prior to colostomy, the last one being on the day of the colostomy. Another case was operable on admission but had had a colostomy performed before admission. That patient is well.

Let us consider here another interesting group—those who came with an operable tumor. There are 12 in all, and we find that 6 are well (50 per cent), 5 were benefited (41.6 per cent) and one left unbenefited (8.4 per cent).

Five of these cases were treated with radium alone. (The choice of radium therapy over operation was made because two refused operation, one chose radium in preference to operation, and in one radium was given because operation would destroy the sphincter. In the fifth case no note was found on the history why radium was chosen.) Of these 5, 2 are well—one 7½ years (this one was a basal cell carcinoma) and one 10 years, two were

TABLE VII.—OPERABLE ON ADMISSION

	Radium	Radium and operation	Radium and colostomy
Well	2—50%	3—50%	1—50%
Improved	2—50%	3—50%	0
Unimproved	0	0	1—50%

improved and only one not improved. The last mentioned did not yield to treatment, necessitating a colostomy 6 months later.

In 6 cases the combination of operation plus radium was used. The operative procedure consisted of either perineal resection or the Kraske method of extirpation, depending on the site of the lesion. Three of the six are well—5, 7½, and 8½ years respectively. Two of the well ones were radiated after and one before operation. Two of the improved cases were operated upon following radium treatments and diminution in the size of the tumor. (One of these was too old to stand the shock of the operation, the other lived 3 years.) The third case was operated upon twice and radiated after each operation—improved and lived 2 years.

The eleventh case of the operable group had a colostomy done before coming to the hospital, having been diagnosed inoperable carcinoma at previous exploratory laparotomy—but by us operable. He has remained well for 9½ years after radium treatments. The twelfth case had radium followed by a colostomy but was not benefited.

Table VII visualizes this group of cases which were operable on admission.

It is interesting also to observe the length of time the patients in all these various groups have been benefited (Table VIII). The following table is based on the duration of life after the date of admission, as the majority of cases were treated up to or within a few months of death:

Cured cases. In any method of treatment the great question is "how many cures?" In the 200 cases under discussion we find that there are 22 (11 per cent) apparently cured ranging from 1 to 10 years.[1] Fourteen of the

[1] In addition to these 22 cured cases, there is one which had an exploratory operation before admission and was pronounced inoperable carcinoma. The tissue taken at our examination was diagnosed "probable benign papilloma." When last heard from, 1 year after treatment, patient was well.

TABLE VIII

Lived less than 6 months but benefited	25
Lived 6 months and benefited	14
Lived from 6 months to 1 year and benefited	43
Lived from 1 year to 18 months and benefited	20
Lived from 18 months to 2 years and benefited	14
Lived from 2 years to 3 years and benefited	10
Lived from 3 years to 4 years and benefited	5
Lived from 4 years to 5 years and benefited	1
Lived from 5 years to 6 years and benefited	1
Total	133

22 (7 per cent of the total number) remained well for five years or longer. These "cured cases" may be divided into three classes: (1) those cured by radium alone, (2) those cured by radium plus operation, (3) those cured by radium plus colostomy.

In the first class belong 8 cases or 4 per cent of all cases treated. Of the 200 treated, 94 had radium alone; and of these, 8 are well. In other words, radium in itself claims a cure of 8 cases out of 94 treated or 8.4 per cent of all cases where radium was used exclusively. In dealing with the second group let us premise before stating statistics: this group contains those who have had radium plus operation with in some cases a colostomy, especially where a colostomy was done in preparation for the operation. The emphasis here, however, is to be placed on the operation-radium therapy in contradistinction to the radium-colostomy group. There are 58 cases in this group with a cure of 11 cases or 17.5 per cent, or 5.5 per cent of the total number of cases in the series of 200. Seven of the 11 cured cases were sent to the hospital after operation. Two cases were recurrent after the operation and have remained well 7 and 9 years respectively. The remaining five were given prophylactic radiation only and have remained well: one, 2, two, 7½, one, 5, and one, 8 years. One of the recurrences was so bad that an immediate colostomy was required on admission in addition to radiation, but the patient has remained well 9 years. Of the 4 operated upon after admission there are 2 which were operated upon after radiation—one in which a Kraske was done 3 months after the last radium treatment and one in which a vaginal resection was done 1½ months after radiation. The first is well 7½ years, the second is well 4½ years. One case was operated

upon after admission but *before* radiation and remained well one year but died from shock after two other operations for prolapsus. The fourth is still living 8½ years after the first treatment, some treatments having been given before and some after operation.

In the third class, those cured by radium and colostomy, there are 3 cases or 1.5 per cent of all treated. In the entire series there were 48 patients who had a colostomy in addition to radium; that is, 6.3 per cent of the colostomy-radium group are cured, or 3 out of 48 cases.

To summarize briefly the cured cases, we may say that operation-radium therapy cured 17.2 per cent of its series, radium alone cured 8.4 per cent and colostomy-radium cured 6.4 per cent. In analyzing the 22 cured cases we find that the periods of cure have been as follows:

TABLE IX

	Cases		Cases
Well 10 years	1	Well 4½ years	1
Well 9½ years	1	Well 4 years	1
Well 9 years	2	Well 3 years	1
Well 8 years	3	Well 2½ years	1
Well 7½ years	3	Well 2 years	2
Well 7 years	1	Well 1½ years	2
Well 5 years	2	Well 1 year	1

CONCLUSIONS

1. Radium used alone or with some operative procedure is par excellence our most valuable therapeutic agent in the treatment of cancer of the rectum in all stages. Its therapeutic value lies both in its palliation and its high percentage of cures—11 per cent of those treated. As a palliative measure it benefited 62 per cent of all the cases. In the hopeless group radium is valuable in giving relief to various symptoms and affording comfort for the remainder of life. There are a number (27 per cent of the total) who did not respond and these we term for the present as not "radio-sensitive." In this group the tumor was fixed in 40 per cent, and practically all were well advanced. The one way to determine the radio-sensitiveness of a tumor is a substantial treatment followed by careful observation; in other words, the great benefits to be expected from radium justify its trial in every case of cancer of the rectum.

2. As to the best method of radium application, sufficient data are not at hand at present to draw positive conclusions. We feel that we must give the implantation of needle points a fuller trial as we believe that it alone, or it combined with other methods, will yield the highest percentage of improvement and of cures. At present we can say that uniformly, whether by radium alone or in combination with operation and colostomy, a combination of external and internal application gives the highest percentage of palliation, while the radical operation plus external treatment yields the highest percentage of well patients, namely 32 per cent, and external treatment in cases where there was no operation gave a cure of 11.1 per cent.

Briefly, the procedure in treating a case of carcinoma of the rectum as indicated by our results would be: (1) If the case is operable, radiate and operate, there being little choice which should be done first, but especially radiate externally. If all the growth cannot be removed, either treat internally as well as externally or implant bare glass needle points if sufficient growth remains after the operation. This can be done at the operation. (2) If the patient is inoperable or a border-line case, treat heavily with external and internal radiation and implant in the hope of bringing the tumor to an operable size or causing it to disappear entirely. If it becomes operable, operate and radiate again, if necessary. If there is postoperative recurrence, radium offers excellent palliation and a good chance of cure. Of all the well cases, 9.9 per cent were recurrent after previous operations. (3) If on admission there is obstruction, a colostomy should be done; however, from our statistics it does not seem wise to do a colostomy as a routine or even as an expedient measure unless there is obstruction.

Finally, in this series radium therapy has been helpful in obtaining 11 per cent cure and a 62.5 per cent palliation of all cases in the series of 200 suffering from carcinoma of the rectum treated in our hospital.

TUBERCULOUS TENOSYNOVITIS OF THE HAND

A Report of Fourteen Cases of Tuberculous Tenosynovitis[1]

By ALLEN B. KANAVEL, M.D., Chicago

THE accompanying report of fourteen patients with tuberculosis of the tendon sheaths of the hand, who have been under my care during the past few years, serves to emphasize the necessity for early recognition of this condition and the possibility of complete cure by adequate and properly directed treatment. The necessity for early recognition is emphasized by the fact that fragmentation of one or more tendons was present in six out of fourteen patients; secondary involvement of the wrist in two; and osteomyelitis of the index finger in one. These complications in my judgment were secondary to the tendon sheath involvement. The possibility of complete cure is attested by the results presented in several patients observed over a number of years.

ETIOLOGY

The ages of these fourteen patients varied from 19 to 60; one was 51, another 42, and eleven were in the third decade of life. The four with tuberculosis of the dorsal sheaths were 21, 26, 27, and 28 years respectively. While no age is exempt, the disease shows a predilection for the early years of adult life.

The influence of trauma as an etiological factor cannot be denied, although specific instances may be lacking. One of my patients was a shoemaker, another an artisan who constantly handled tools, and another a mail clerk. That trauma is a dominant factor is improbable, since in four patients the lesion involved only the dorsal tendons; but it is doubtless more than a coincidence that in all but one case the right hand was involved, and the single case of involvement of the left hand occurred in a left-handed individual. Similar observations concerning the hand involved have been made by other writers.

The possibility of infection entering through the skin of the hand itself is suggested by the sequence of events in the case of a patient who noticed first a small nodule on the thumb, which he himself picked off. Removal of this nodule was followed by a discharge of pus. After the infected area was incised, it remained healed for a time; but in a month the discharge reappeared and continued intermittently for about a year, when the patient noticed that the wrist was swollen. Not until then did he come for operation. In this particular case it cannot be denied that the tuberculous process may have been present in the tendon sheath previous to the appearance of the nodule on the thumb.

In only one of my patients was there a demonstrable lesion in the lungs, and none had evidences of tuberculosis elsewhere. I am informed, however, that in sanitaria for tuberculosis, tuberculous disease of the tendon sheaths is not at all uncommon as a complication or sequela of pulmonary tuberculosis. That it is frequently present without an evident lung involvement is certain.

PATHOLOGY

Our knowledge of the disease dates from the observation of a case recorded in 1756 by Olaf Acrel, of Stockholm. This report was followed by others from Dupuytren, Velpeau, Laennec, Cloquet, and later by observations from German writers,—Heineke, Virchow, Brodie, and others. One of the earliest comprehensive studies was made by Michon, who apparently recognized the tuberculous nature of the disease; but it remained for Hoeftmann to demonstrate the presence of giant cells and tubercles.

The disease may appear in various forms. In the simplest type, a serous exudate alone is present. Later, granulation tissue and rice bodies appear, and, finally, in the severest forms, fungus formation and extensive necrosis take place. These variations are doubtless due to the duration of the disease, the varying resistance of the individual, and the varying

[1]Read before the American Surgical Association, Rochester, Minnesota, May 31, June 1 and 2, 1923.

a *b* *c*

Fig. 1. Tuberculous tenosynovitis of ulnar and radial bursæ (*a*, *b*) with perfect functional result after operation (*c*).

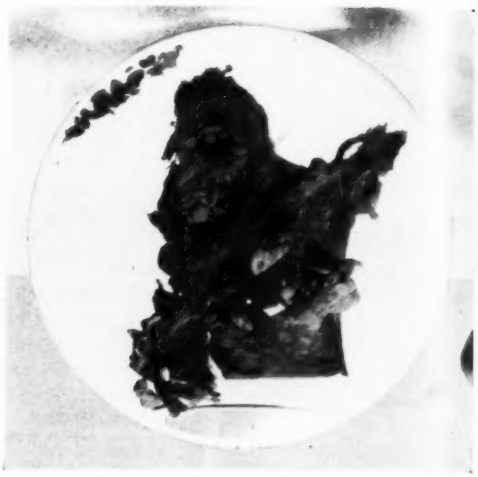

Fig. 2. Hygromatous form of tuberculous tenosynovitis with melon seeds (from patient in Fig. 1).

toxicity of the organism. In my own patients all of these variations in pathology have been observed.

The affected area, whether it involves the dorsal or volar surface of the forearm, the wrist, the palmar surface of the hand or the individual fingers, appears as a more or less spindle-shaped swelling (Figs. 1, 3, 5, 6, 8, 9). This swelling may give a definite sense of fluctuation; it may be doughy; it is rarely hard and firm. Early in the course of the disease it may be so ill defined as to leave a question as to its actual presence.

On incising the skin over the affected area, the deep fascia appears more tense than normal, and the fascia and superficial tissues may appear slightly œdematous. On incising the deep fascia, evidence of pathological change immediately appears. The tendon sheaths are no longer white, and glistening, but yellowish-white, grayish-red, gray, purple, or bluish-purple. Instead of herniating quickly through the smallest opening in the deep fascia, the œdematous tissue tends to herniate into the wound only when an incision of some length is made. On incising it, this œdematous tissue is found to consist of the thickened tendon sheaths and tendons, more or less closely matted together (Fig. 10). If the process is not far advanced it is possible to separate the individual tendons from one another. Then it may be seen that the involved tendons, with their sheaths, form a fusiform enlargement. The vascular sheath varies in thickness from 0.5 to 3 millimeters, depending on the duration of the disease. On incising the sheath the thickened tendon appears within it (Fig. 11, B). Much of the fusiform enlargement disappears as thin, straw-colored fluid pours from the open sheath. The thickened tendon is still free in the sheath, and on incising the tendon, it is found that the thickening is due to involvement of the visceral layer of its sheath. The white fibrous tendon is still intact within the soft, vascular granulation tissue which has replaced the normal, tissue paper, visceral layer of the tendon sheath. During this stage the tendon can still be dissected out of the tuberculous sheath and shows little or no pathological change. This is the earliest stage of the so-called hygromatous form.

In a later stage the sheath becomes partially obliterated by fibrous tissue formation. Fluid is confined to a definite portion of the sheath, and rice bodies may appear in the fluid.

Still later the fluid is replaced by a caseous substance which may be localized in one or two areas. The tendon sheath is replaced by granulation tissue, and later by fibrous tissue; fragmentation of the tendons takes place (Fig. 12), and several tendons, or all of them,

a *b* *c*

Fig. 3. Tuberculous tenosynovitis of ulnar and radial bursæ with plastic repair of the tendons. *a*, before; *b*, immediately after; *c*, 2 years after operation.

may be firmly bound together in a mass of fibrous tissue.

The description of the findings at operation in two of our cases is very characteristic. In the first case (C., Wesley Memorial Hospital No. 86002), the report is as follows: "The tendons looked bluish, distended, and much thickened. On opening the tendon sheaths, the apparent enlargement was seen to be due to a homogeneous mass of granulation tissue, which in places seemed to be breaking down and to look caseous. This tissue surrounded the individual tendons like a sheath." In another case (S., Wesley Memorial Hospital No. 103348), the report states: "The tendons of the four fingers were involved from a point 2 inches above the volar carpal ligament to the webs of the fingers. In the distal half of the palm, a little to the ulnar side of the midline, was a definitely encapsulated mass, the size of a small egg, filled with sago-like substance, but without fluid and without melon seeds (Fig. 5). To the wall of this mass the tendons of the third and fourth fingers were firmly adherent. All traces of the tendon sheaths of the four fingers had disappeared, and the isolation of the individual tendons from the fibrous tissue which bound them together was extremely difficult."

These varying conditions, described as characteristic of different stages of the disease, may at times be seen in the same individual. Straw-colored fluid with rice bodies may be present in the radial and ulnar bursæ while the tendons of the fifth finger in the palm have undergone almost complete fragmentation and division. Such fragmentation can occur while the tendon still moves freely in its sheath.

The final stage of the uncomplicated disease, the fungus form, is characterized by extensive formation of granulation tissue and caseation, with or without rice bodies. The exposed tuberculous mass is very vascular, soft, and of a grayish-red or purple color. It looks like a sausage-shaped enlargement which has replaced the tendinous mass. When the soft, thick granulation tissue forming its outer wall is incised, the interior of the tendon sheath with the involved tendon is exposed. There may be some thick, gelatinous, straw-colored fluid present; there may be rice bodies (Fig. 2); there may be only caseous material within the synovial space (Fig. 5). At times the swelling may be bilocular, with rice bodies present in one loculus and gelatinous fluid in another. The lining membrane of the tendon sheath is no longer glossy and shining, but dull and lusterless. It may be adherent to the tendon in a part of its course; it frequently shows areas of caseation and necrosis.

The visceral layer of the sheath is involved like the parietal layer. The extent of involvement of the tendon contained within it depends on the duration of the disease. Fragmentation and division of the tendons are the ultimate result. Union of several or all the tendons in a thick mass of scar tissue represents nature's attempt at cure. It was this

a *b* *c*

Fig. 4. Tuberculous tenosynovitis of ulnar and radial bursæ. *a*, before; *b*, *c*, after operation.

particular type of tuberculous disease which lead both Lisfranc and Chassaignac to make a diagnosis of sarcoma in lesions which Michon later showed to be tuberculous.

Eventually, if healing by fibrous tissue formation fails to limit the pathological process, extensive caseation takes place, the involved tissues break down, sinuses are formed, and finally a secondary infection is superimposed on the tuberculous process.

Any of the individual tendon sheaths may be involved, but multiple involvement seems to be more common on the dorsum than in the palm. The palmar involvement follows strictly upon anatomical lines, so that we may have isolated involvement of the tendon sheaths of the index, middle, and ring fingers; but if the process involves the little finger or thumb primarily, both ulnar and radial bursæ are involved in nearly every case. An ulnar bursal infection is practically always followed by extension to the radial bursa, and the converse is also true, and in both instances the extension of the bursæ above the wrist shows involvement. When the melon seeds rupture into the forearm, they are always found lying upon the pronator quadratus and the interosseous septum, under cover of the flexor profundus digitorum. In one of my patients there was involvement of the ulnar and radial bursæ with simultaneous involvement of the tendon sheath of the ring finger, and in another patient a tuberculosis of the tendon sheath of the index finger (Fig. 6) developed 6 years after operation for a tuberculous process involving the ulnar and radial bursæ. During the intervening 6 years there was no clinical evidence of a tuberculous process in the index finger.

Upon the dorsum multiple sheath involvement is more common (Figs. 8, 9).

It is an interesting observation that while there was often fragmentation of tendons—in six out of fourteen patients—in only one case were the tendons of more than one finger destroyed. In one case the tendons of the index finger were involved, in two those of the little finger; in a fourth case the flexor longus pollicis was involved, and in the fifth case the extensor longus pollicis. In our last case, a definitely encapsulated mass had formed in the palm (Fig. 5), to the wall of which the fragmented tendons of the third, fourth, and fifth fingers were adherent. In ulnar bursal infection, destruction of the tendons of the little finger is most common.

Attention should be drawn particularly to the involvement of the median nerve in tuberculosis of the ulnar and radial bursæ. The anatomical relations of the nerve in the forearm, at the wrist and distal to it, are such that it must inevitably be involved in the process (Fig. 10). While in my cases it has always been surrounded by the tuberculous mass, in no case has there been destruction of the nerve, although it is frequently swollen and hyperæmic.

Tuberculous tenosynovitis does not tend to become generalized or to involve the regional lymph glands, although one of my patients presented a tuberculous focus on the skin of the forearm of the elbow. Either the hygromatous or the fungoid form may extend to the surface, or to joints, and produce typical skin and joint lesions with fistulæ. Cold abscesses seldom, if ever, appear, but following the formation of fistulæ acute inflammatory processes may develop, with all the serious consequences that follow suppurative tenosynovitis. Rupture of the hygromatous sheath into the forearm with the extension of rice bodies under the flexor profundus often occurs, while less often there may be a rupture into the middle palmar space, as was shown in one of my patients (Y., Wesley Memorial Hospital No. 37802).

The histological picture is that of tuberculous tissue elsewhere, with much endothelial proliferation, with an irregular connective-tissue ground substance, interspersed with giant cells in its deeper layers, with tubercles and with coagulation necrosis. The involved tendons as well show giant cells in many places (Fig. 7).

During the earlier years great controversy raged over the origin of the rice bodies and melon seeds, which had been compared by Acrel to cooked sago. Dupuytren was the first to call attention to the central cavity that is often found in these bodies. He believed them to be hydatid cysts and to contain parasites. Laennec, Hipp, Cloquet, and the parasitologist, Chiajie, concurred in this theory, so that the disease became known as Dupuytren's hydatid tumor. The majority of observers believed the rice bodies to be unorganized concretions arising from the coagulations of the fibrin in the synovial fluid of the tendon sheaths. Velpeau called attention to the presence of similar bodies in joints and mucous bursæ, and believed they were developed from fibrin, lymph, and some from pus. Hyrtl in 1842 described a case in which rice bodies seemed to be necrotic portions of the tendon sheath wall. After Michon (1851) called attention to the organized nature of these bodies, Virchow suggested that they originated from the coagulation of an albuminous substance, and was seconded in this theory by Heineke, Brodie, Beger, and Koenig. Better staining methods and further study demonstrated that they have their origin in the degeneration products of the tuberculous granulation tissue and contain, in addition, accretions from the fibrin deposit. The exact origin of the rice bodies is an academic question, but the fact that their presence is pathognomonic of tuberculosis is of importance, although isolated cases are reported in which tuberculosis has not been demonstrated.

The histological picture of a rice body presents chiefly fibrinous material, which contains here and there a giant cell with the bacillus tuberculosis. Goldmann and Garre showed that these bacilli are capable of producing tuberculosis in a guinea pig, if the rice bodies are implanted in the peritoneal cavity, although not all the bodies contain bacilli.

Fig. 5. Fungoid form of tuberculous tenosynovitis.

SYMPTOMATOLOGY

In general the symptoms and signs are those of a slowly developing enlargement of the involved area, with impairment of function of the tendons and of the median nerve. At first the patient complains only of a stiffness of the hand, an inability "to make a fist." There may be no history of spontaneous pain. At certain stages of the disease a leathery crepitation may be felt and heard on movement of the tendons, but this soon disappears and is generally not elicited when the patient presents himself for treatment.

The swelling follows the anatomical outline of the sheath involved. In the case of the ulnar and radial bursæ, there is a fullness at the base of the palm, more marked upon the the ulnar side. Above the annular ligament the lower part of the volar surface of the forearm is enlarged (Figs. 1, 3, 5). If the two hands are held up side by side and observed from the lateral aspect, the relatively greater thickness of the affected arm is clearly seen (Fig. 8). Pressure above the wrist will cause the palmar swelling to become more tense.

Owing to the involvement of the median nerve, the patient not infrequently complains of numbness and tingling, particularly on the sides of the index, middle, and ring fingers, and often impairment of sensation can be demonstrated. One might expect that the

Fig. 6. Tuberculous tenosynovitis of index finger secondary to tuberculous tenosynovitis of ulnar and radial bursæ successfully operated upon 6 years previously.

congestion of the nerve would give rise to much pain, particularly in the early stages, but this complaint has not always been present. In one case, however, the character of the pain and its course were so typical of what one would expect that the history with reference to this symptom is taken from the interne's record (R., Wesley Memorial Hospital No. 92841). "About three years ago, as far as the patient can remember he lifted something and noticed some slight pain in this wrist joint. About 12 hours later the pain became very severe, and a swelling appeared over the flexor surface of the wrist joint, and, to a slighter degree, over the thumb. During the succeeding weeks the swelling fluctuated in size, but a dull pain was constantly present and was aggravated by motion. The pain was seemingly worse at night, and for 6 months the patient would get up two or three times at night, unable to sleep on account of the excruciating pain. About 3 weeks after the onset he noticed a numb feeling over the middle and ring fingers and a stiffness in his joints. For the past 2 years there has been comparatively no pain."

In our last case the history dates back 7 years. The patient first noticed a swelling about the ulnar side of the wrist, and pain which extended up the forearm and down the

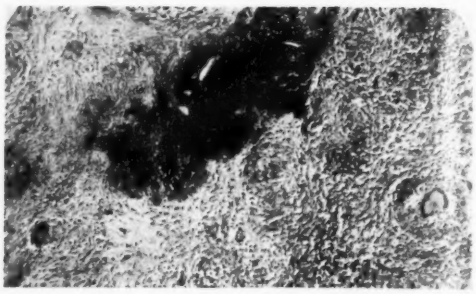

Fig. 7. Cross section of tendon removed from patient in Figure 6, showing characteristic tubercle formation.

fingers. This pain was described as a "terrible burning," so that the patient frequently got up at night to plunge her hand and forearm into ice-cold water. She sought one doctor after another and applied lotions, ointments, and packs without affecting the pain in any appreciable degree. A year after the onset, the severity of the pain diminished very markedly, and for the past 6 years there has been little spontaneous pain. Another patient whose history extended over a period of 18 months stated that for the first 6 months she had severe burning pain throughout the hand and forearm, particularly at night, and when the hand was elevated. She hung the arm over the side of the bed to relieve the pain, and frequently got up at night to plunge it into a reservoir of hot water which stood at the back of the kitchen stove.

When rupture of the melon seeds from the ulnar bursa into the palm has taken place, the middle palmar space is involved and the concavity of the palm is lost. When the rupture has occurred into the forearm, a general swelling of the entire flexor part of the lower half of the forearm is noted. Even before fragmentation of the tendons occurs, there is partial loss of function of the fingers involved. Stiffness, swelling, the inability to flex or extend the finger completely, are the earlier symptoms. Loss of power and finally inability to move the fingers indicate extensive involvement of the tendons.

When the tendon sheaths on the dorsum are involved, the patient complains of little except stiffness, and a fluctuating swelling over the anatomical outline of the sheaths. There is

a *b*

Fig. 8. Tuberculous tenosynovitis of the dorsal tendon sheaths of the left hand and wrist, *a;* the right hand and wrist, *b*, are normal.

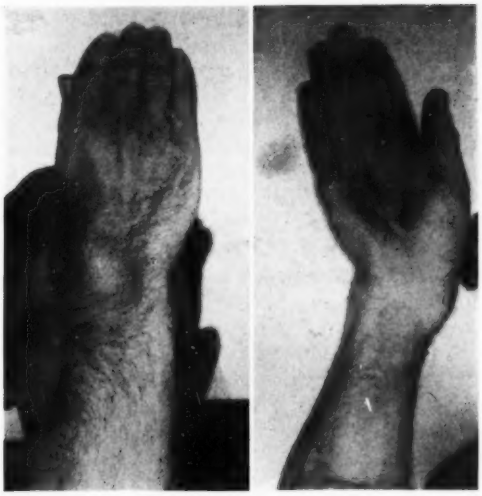

Fig. 9. Tuberculous tenosynovitis of the dorsal tendon sheaths.

little limitation of motion and little or no pain and tenderness. Crepitation may be felt at certain stages of the disease.

In old neglected cases and those with bone and joint involvement, fistulæ form, secondary infection ensues, and the typical well-known picture of joint and bone tuberculosis is presented.

Systemic symptoms are so slight as to be of no importance, but other foci of tuberculosis should always be sought.

TREATMENT

Tuberculosis of the tendon sheaths, if unaccompanied by active lesions elsewhere, is probably one of the least difficult of tuberculous processes in which to obtain complete cure. This may be secured either by conservative treatment such as removal of the melon seeds, injection of iodoform emulsion, and immobilization by splinting for a considerable period, or by complete surgical removal. The former method requires considerable time for its application, with consequent loss of use of the hand. As a result of prolonged immobilization, atrophy and contractures of the muscles take place, fibrous adhesions form about the joints, and these conditions are accentuated by the temporary loss of nerve function and by the involvement of the nerves in the pathological process itself. These results, however, are usually transitory, and function is restored some weeks or months after removal of the splints. It may be advisable to combine active surgical intervention and immobilization in advanced cases, if the bones and joints are involved in the process.

In my earlier cases, the first method was utilized, but in later years the results obtained by complete dissection have been so excellent, both as regards eradication of the disease and the prompt restoration of function, that this method has been used exclusively. I have several patients treated some years ago by the conservative method in whom good results were obtained, but the records are inadequate and I have not been able to get them to return for a verification of the result, so that, with one exception, these are not included in the present report. The exception is that of a patient (Y., Wesley Memorial Hospital No. 37802), who was first observed in 1912. He was suffering from tuberculosis of the ulnar and radial bursæ with extension into the palmar space and the forearm, with several tuberculous sinuses, and with probable involvement of the wrist joint. Short incisions were made in the palm and in the forearm, the melon seeds present were

evacuated, and an injection of 10 per cent iodoform emulsion made. Splints were applied for a number of months. Meanwhile iodoform emulsion was injected into the sinuses from time to time and tuberculin was administered. After about a year the process seemed to have been entirely eradicated and he began to use his hand. Three years later he came under the care of another surgeon, with a recurrence at the wrist. Splints were reapplied for 6 months, and since the expiration of that time he has been entirely well except for some limitation of motion at the wrist joint. He was examined in May, 1922, and showed no evidence of active tuberculosis either in the wrist or elsewhere. The severity of the condition when this patient first came under our care and the long period during which he has been under observation show conclusively the possibility of cure by conservative methods. This fact is confirmed by others and by my own experience in other cases that I have not been able to follow so closely.

I have not included in this critical survey two patients with tuberculosis of the dorsal tendon sheaths in which the process was in the incipient stage, and in which immobilization was resorted to without other procedures —a method which would seem entirely justifiable in early cases or in those patients suffering from active tuberculosis of the lungs.

Thirteen of the patients used for study in this contribution were treated by active surgical intervention. For study these should be divided into tuberculosis of the sheaths of the flexor surface and tuberculosis of the dorsal tendons. This division is necessary, since the technique of treatment is different and, in my hands, unfortunately, the results have not been similar.

SURGICAL TREATMENT

The operation is always done under local anæsthesia—one-half per cent novocaine is injected above the clavicle so as to block the brachial plexus. If nerve blocking is not entirely satisfactory, it is supplemented by infiltration of the ulnar nerve at the elbow and at the site of incision, and by infiltration of the median nerve after its exposure in the wound. After the hand is surgically prepared a rubber glove is drawn over it and the glove incised at the site of operation. A bloodless field is secured by maintaining constriction with a blood-pressure apparatus at twenty points above the systolic blood pressure. The constriction is released at the end of an hour and restored later if necessary; but, if the dissection is done carefully, it is usually possible to complete the operation without renewing the constriction.

By regulating the degree of constriction with the blood-pressure apparatus, and maintaining as low a pressure as is consistent with hæmostasis, the danger of producing a musculospiral paralysis from excessive tension is avoided.

Nine patients with tuberculosis of the flexor tendon sheaths have been subjected to a complete resection of the tuberculous tissue with restoration of function in every case. In the early case the dissection was supplemented by splint immobilization for varying lengths of time. This period has been gradually shortened until now immobilization is not considered necessary except in those patients who may be suffering from a complication of the disease, such as bone or joint involvement. We realize that the number of patients observed is too small to warrant dogmatic statements, but that permanent and satisfactory results may be obtained without immobilization is shown by the successful results in the patients who have been under our care. The avoidance of the disability due to immobilization is a strong argument in favor of early mobilization.

Since, in every case, in which the ulnar bursa has been involved, there has been involvement of the radial bursa also, the operation should be designed so as to reach both bursæ. The technique used in such cases is as follows:

An incision is made upon the flexor surface of the forearm and hand, from 3 inches above the wrist down to the distal flexion crease of the palm (Fig. 10). The incision is made over the middle of the forearm, and extends into the palm at the radial side of the hypothenar eminence. If the tendon sheath of the little finger is involved farther distalward, the in-

cision may be continued to the radial side of the fifth finger as far as necessary, but this extension of the incision is avoided if possible. If the sheath of the flexor longus pollicis, which is directly continuous with the radial bursa, is involved, a second incision is made to ensure an adequate exposure. This incision begins a thumb's breadth below the anterior annular ligament, curves radialward around the thenar eminence and extends distalward on the thumb as far as is necessary. Such an incision will avoid injury of the motor branch to the muscles of the thenar eminence, a branch given off by the median nerve just below the annular ligament.

The incision on the flexor surface of the forearm and palm is continued through the anterior annular ligament and the palmar fascia. The ligament is not sutured after the operation, and I have never seen disability result from its incision.

The first structure sought in the forearm is the median nerve (Fig. 10). This is followed into the palm, the greatest care being exercised to preserve every filament. To aid in the dissection it is my custom to use a pair of spectacles which magnify the tissue about one and one-half times. This has the disadvantage of bringing the operator's face closer to the field, but the advantage of enabling him to recognize and preserve the nerve filaments and small blood vessels. The median nerve is often found completely surrounded by tuberculous tissue, but I have never seen it invaded, although it may be inflamed and swollen to twice its normal size.

When the median nerve has been isolated from the tuberculous tissue and protected by gauze saturated in salt solution, the dissection of the tendons and the removal of the tuberculous tissue is carried out. Each tendon is raised in turn and with a fine, sharp knife the thickened visceral sheath is dissected away (Fig. 11). One is surprised at how little injury most of the tendons have sustained. Usually the tuberculous sheath may be removed and an apparently intact tendon is left behind. As each tendon is freed one holds it aside and passes to the next, the tuberculous tissue meanwhile remaining in one mass or at the most in two.

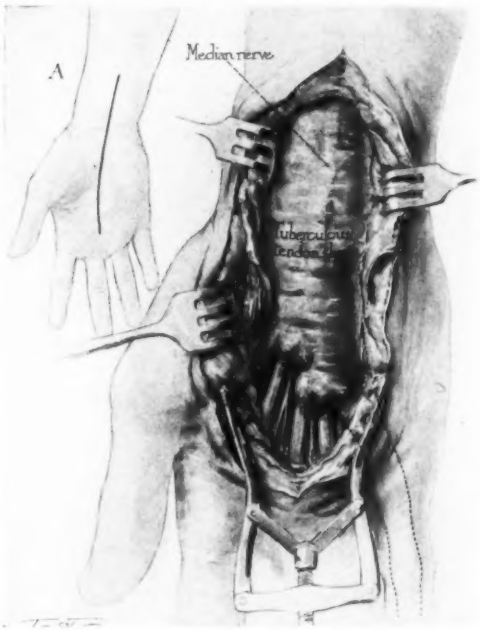

Fig. 10. Operative incision and appearance of tuberculous tendon sheaths.

After the forearm and wrist are thoroughly dissected, one passes into the palm and completes the dissection, using redoubled care not to cut any of the nerve filaments and to avoid injury to the blood vessels as much as possible. The prolongation of the ulnar bursa along the tendons to the little finger requires especial attention. If the sheath going to the little finger or thumb is involved (and involvement of either one is common), both layers of the tendon sheaths are completely removed through the incisions described. It is important not to leave the slightest vestige of tuberculous tissue.

Not infrequently one or more tendons may be found fragmented, but the remaining tendons will be found intact. If the destruction has been slight, I have left the affected tendons in some instances, but have generally felt it advisable to excise the diseased tendon. If the destruction has been in the palmar area, and in ulnar and radial bursal tuberculosis that is its customary location, one can secure excellent functional results by attaching the

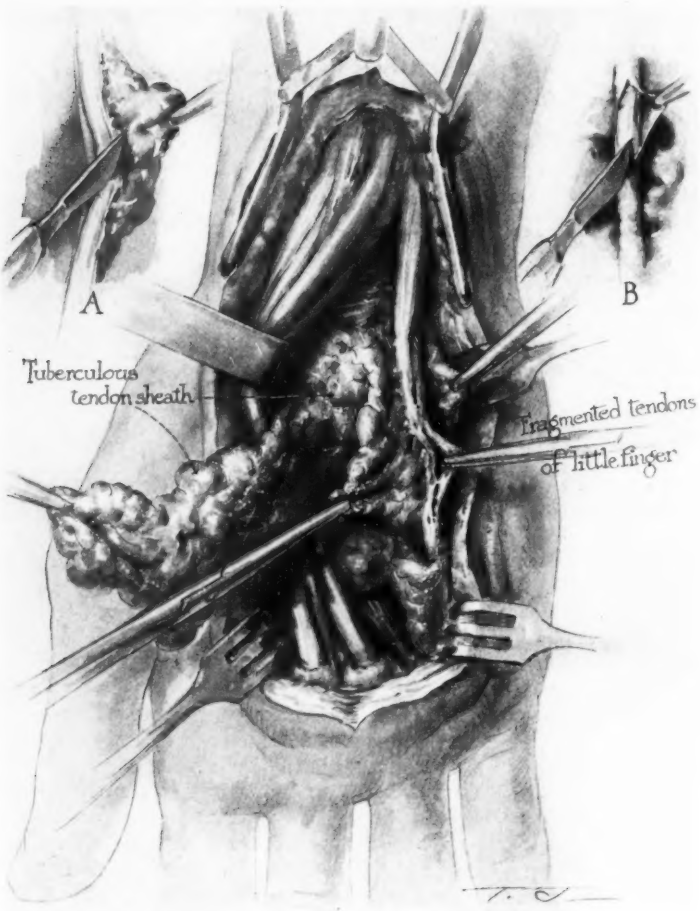

Fig. 11. Method of dissection of the tuberculous tissue.

severed ends to the corresponding adjacent tendon, care being exercised to attach them at the proper site to secure the same degree of flexion in both fingers (Fig. 12, A). Since the operation is performed under local anæsthesia, and since the infiltration of the nerve has begun to lose its effect by this time, it is possible to determine the proper site for attachment by inserting a temporary suture and asking the patient to flex his fingers. Prolonged pressure from the Martin bandage or the blood-pressure apparatus will paralyze the nerve temporarily so that contraction of the muscles may be impossible, but a proper appreciation of the relative position of the two fingers and of their tendons will enable one to attach the severed tendon at the proper site. The proximal end of each cut tendon is also attached under slight tension to the corresponding adjacent tendon above, thus ensuring some slight degree of individual motion, a result somewhat surprising to me.

All hæmorrhage is carefully stopped, and it has been my custom to leave in the wound a small amount of iodoform powder suspended in ether. The incision is closed without drain-

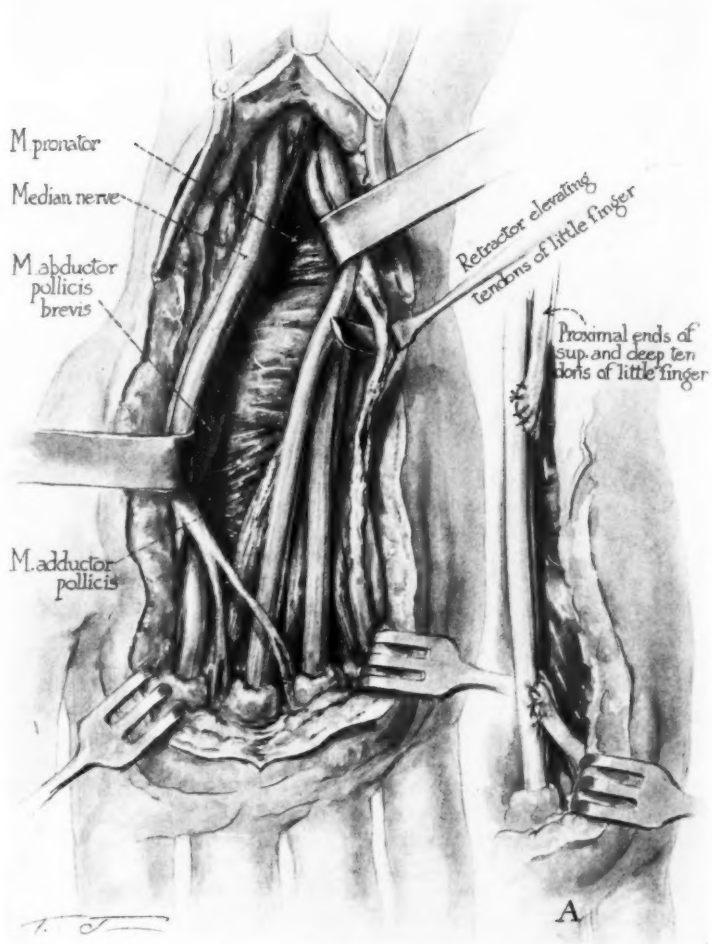
M. pronator
Median nerve
M. abductor pollicis brevis
M. adductor pollicis
Retractor elevating tendons of little finger
Proximal ends of sup. and deep tendons of little finger
A

Fig. 12. Appearance of tendons after the removal of the tuberculous tissue. *A*, plastic repair of fragmented tendon.

age. No splint is applied, and the patient is told to use the hand for ordinary simple duties as soon as it is healed.

Under this treatment none of these nine patients has had a recurrence and all have practically complete function of their hands, with the exception of the cases in which the tendons have been excised. Due to the plastic procedure mentioned, these cases have very little disability. The photographs presented show the after-result in some of these patients.

In two patients, as noted above, tuberculosis was subsequently found in other tendon sheaths. In one case (O., Wesley Memorial Hospital No. 46977, Fig. 6), tuberculosis of the tendon sheath of the index finger was discovered six years after the operation upon the ulnar and radial bursæ. Whether this was present at the time of the primary operation and developed slowly, or whether it developed subsequently cannot be said; but it is certain that there was no recurrence in the palm or

forearm. This was a particularly favorable case for observation since the patient was a shoemaker, and while he refrained for a year from using his hand strenuously, he worked at his trade throughout that time, and during the next 5 years used it as he had always done, without any attempt to favor it.

The other patient (R., Wesley Memorial Hospital No. 92541), returned 6 weeks after operation with evidence of a tuberculosis of the sheath of the tendons of the ring finger. Here it is certain the lesion was present at the time of the first operation and overlooked. He also had a nodule on the skin of the forearm at the elbow. This was removed at the time of the first operation. He also has remained entirely well to date, a period of more than 2 years.

My experience with tuberculosis of the tendon sheaths of individual fingers is limited to the two patients just mentioned. In one there was a tuberculosis of the tendon sheath of the ring finger and in the other of the index finger. The former presented the typical proliferation of tuberculous granulation tissue upon both the parietal and visceral surfaces of the sheath, the history stating that this was more extensive upon the superficial than upon the deep tendon. Rice bodies filled the cavity. Under local anæsthesia an incision was made upon the flexor surface, from the distal flexion crease of the palm to the distal end of the middle phalanx. The entire sheath was dissected away and the tuberculous tissue dissected from the tendon. Fortunately fragmentation of the tendons was not present. The wound was closed and the patient permitted to use the finger as soon as the primary wound was healed. A complete functional result was obtained, as will be seen by examining the photographs (Fig. 1).

The other patient had suffered for some time with tuberculosis of the tendon sheath of the index finger, and in addition has an involvement of the proximal interphalangeal joint and the distal end of the proximal phalanx. Here it seemed advisable to amputate the finger at the metacarpophalangeal joint, and remove the tendons for some distance proximal to this point. An uneventful recovery ensued, and there has been no recurrence of the tuberculosis during the 2½ years that have elapsed since this operation.

These two cases typify the procedure to be followed. If there is no involvement of bone or joint, and the tendons are not so fragmented as to demand removal, a complete dissection of the tuberculous material will end in recovery, but if any complications are present, amputation should be the operation of choice.

My experience with cases with tuberculosis of the dorsal tendon sheaths in which adequate records were kept and in which I have been able to follow the results over a fair period of time is confined to four patients. Unfortunately the results have not been so satisfactory as with tuberculosis of the flexor sheaths. This was due in one case to incomplete excision and in another to poor judgment in the choice of the type of the treatment.

In two patients the removal of the tuberculous tissue resulted in permanent cures. One patient, in whom a recurrence took place (B., Wesley Memorial Hospital, No. 79844), was suffering at the time of operation from an incipient pulmonary tuberculosis which was suspected but not proven. Some weeks after operation the pulmonary involvement became evident and, later, other sheaths upon the dorsum of the hand became involved, or a recurrence took place at the site of the earlier involvement. Personal examination was not possible, but the history obtained seemed to justify this assumption. At operation no rice bodies had been found; the process seemed to be more acute than usual, and in view of the probability of lung involvement, I believe that immobilization of the wrist, supplemented by hygienic treatment, would have been the better treatment.

The other patient (S., Wesley Memorial Hospital No. 94649), suffered from a typical tuberculosis of the dorsoradial sheath (Fig. 9). Rice bodies had ruptured from the tendon sheaths into the surrounding tissue. Here, resection was attempted, but was not completely carried out, so that a recurrence with sinus formation ensued. The hand was then treated by sun baths and immobilization, with apparent recovery after 9 months.

The history of this patient emphasizes the difficulty of complete dissection of the dorsal sheaths. This can be secured only by the most painstaking endeavor. The sheaths are multiple and pass under the dense posterior annular ligament through separate compartments. These tunnels should be incised, and every vestige of tuberculous tissue including fragmented tendons should be removed.

It is a pleasure to acknowledge the assistance of my associates, Dr. Sumner Koch and Dr. W. H. Woolston in following up the patients and verifying the records.

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ADENOMYOMATA INVOLVING THE SIGMOID[1]

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SPENCER, in discussing a paper by Lockyer, in 1913, was the first to refer to a case of adenomyoma of the sigmoid. In this case there was a tumor about 2.5 centimeters in diameter, involving the serous and muscular coats of the sigmoid colon. In 1914, Leitch reported the case of an unmarried woman, aged 33 years, whose chief complaint was constipation and dull abdominal pain. At operation a loop of the sigmoid was found adherent to the back of the uterus in the pouch of Douglas. There was a small tumor at the point of contact which felt cancerous. On resection of the involved sigmoid, it was found that the tumor did not invade the mucous membrane. There was a small patch of adenomyomatous tissue on the surface of the uterus where the sigmoid was adherent. Meyer, in 1919, reported a case in which operation had been performed by Mackenrodt in 1907, for stricture of the bowel, in a single woman aged 45 years. The sigmoid colon was resected. In the center of the specimen, the lumen of the bowel was reduced to a mere slit; the tumor invaded the lumen as a polyp. The outer layers were much thickened, particularly on the mesocolic side. In 1920, Cullen reported two cases of his own and discussed two cases from the literature. Cullen's patients were 26 and 36 years old respectively, and neither of them had borne children. They both gave histories of severe dysmenorrhœa with abdominal pain and rectal distress at the time of menstruation. Both had definite adenomyomata in the sigmoid, and one of them had a separate adenomyoma in the rectovaginal septum. Sampson recently reported 12 cases of adenomyoma involving the intestinal tract; 5 of these were in the sigmoid: the others involved the rectovaginal septum, the appendix, and the small intestine. In these 5 cases the average age of the patients was 39 years; the youngest was 28 and the oldest 47. All complained of dysmenorrhœa, and all had noted a recent increase, or the occurrence of dysmenorrhœa associated with constipation.

Since January 1, 1911, 5,970 patients with fibromyoma of the uterus have been operated on at the Mayo Clinic. During these years operations have been performed on 494 patients with adenomyomata, of which 464 were in the uterus, fallopian tubes, ovaries, and uterine ligaments, 14 in the rectovaginal septum, 6 in the abdominal wall, 5 in the sigmoid, 3 in the inguinal region, 1 in the umbilicus, and 1 entering the wall of the bladder. Of the 5 cases involving the sigmoid, 1, Case 1 of our series, has been reported by Mahle and MacCarty.

Case 1. (A250372.) Mrs. J. A. M., age 31 years, came to the Clinic, November 7, 1918, because of a tumor of the lower bowel which had been found about 2 months before, when she had undergone an operation for pelvic tumor. At that time her appendix, both tubes, the left ovary, and a cyst from the right ovary, had been removed. She had been married 11 years, and had been pregnant once.

Roentgenograms of the colon and proctosigmoidoscopic examination were negative. At operation, November 14, 1918, a mass was found encircling the sigmoid, and involving a segment of bowel 4 centimeters long. The sigmoid and bladder were adherent to the uterus. Twelve centimeters of sigmoid, and tarry cysts from both ovaries were resected. The growth in the sigmoid was definitely adenomyoma (Fig. 1). The patient reports that she is now well and that her bowels move normally.

Case 2. (A295677.) Miss M. R., age 46 years, came to the Clinic, November 5, 1919, complaining of a dull pain across the lower abdomen. In June, 1914, a subtotal hysterectomy and left salpingo-oophorectomy had been performed because of fibromyomata and inflammation in the left tube and ovary. A stricture of the lower bowel, believed to be inflammatory, was noted at this time. In September, 1914, a colostomy was performed because of acute intestinal obstruction. The surgeon believed that the lesion in the sigmoid was malignant and immediate resection was advised.

At the time of examination, the patient still had dull gnawing pain across the lower abdomen. She was small and slender, but had not lost weight.

[1] Submitted for publication May 7, 1923.

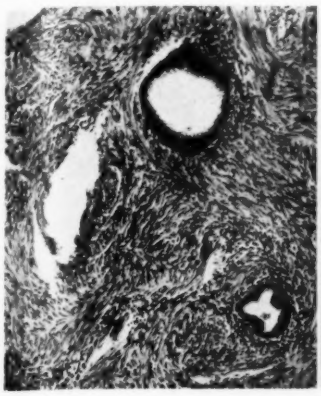

Fig. 1. Case 1. Typical glands of endometrial type surrounded by stroma. (x 50.)

Fig. 2. Case 2. Glands lying in a rather cellular stroma. (x 50.)

Fig. 3. Case 3. Photomicrograph showing dilated gland spaces. (x 50.)

The Wassermann reaction was positive. A satisfactory roentgenogram of the colon could not be obtained because of the colostomy. Proctosigmoidoscopic examination revealed marked narrowing of the lumen of the bowel to one quarter normal size at the rectosigmoidal juncture. The mucous membrane was intact. The narrowing appeared to be due to pressure outside the bowel. November 5, 1919, 9 centimeters of the upper end of the rectum, and 2.5 centimeters of the lower sigmoid was resected, and an end-to-end anastomosis made. An adenomyoma, 2.5 centimeters in diameter, was found 1.5 centimeters from the distal end of the sigmoid (Fig. 2). The mucous membrane was not involved. The patient's recovery was uneventful and after 6 months' rest at home, she returned to the Clinic, and the colostomy was closed. She now reports that she is in good health.

Case 3. (A314099.) Mrs. W. C. F., age 41 years, came to the Clinic April 29, 1920, complaining of pain in the lower abdomen following menstruation. She had developed endocarditis at the age of 15 years, and had always been in rather poor health. Her menses had been regular and not unusual until 2 years before, when she commenced to have pain about the third day, when clots passed, but pain continued for 3 or 4 days after the flow ceased. She sometimes had severe pain in the rectum with residual soreness for several days. She had never been pregnant.

Her heart was found to be slightly enlarged, with the apex 11.5 centimeters to the left. The first sound was greatly accentuated. A mass was found extending up from the pelvis into the abdomen. May 6, 1920, under ether anæsthesia, the abdomen was opened and the mass was found to consist of uterine fibromyomata, and an adenomyoma involving the sigmoid. The growth had passed between the peritoneum and coats of the muscle, but the membrane of the latter was not involved. The left ovary was cystic. Total abdominal hysterectomy, left oophorectomy, and salpingectomy were performed. The right ovary and tube were preserved. The adenomyoma was dissected from the wall of the sigmoid (Fig. 3). The pathologists reported multiple fibromyomata of the uterus, and cystic cervicitis. The largest tumor was 8 centimeters in diameter, and the smallest 3 millimeters. One fibromyoma was cystic and œdematous, and one was undergoing calcareous degeneration. There were polypoid endometritis and multiple adenomyomata of the uterus, the largest 6 centimeters in diameter. The tube contained many small, subserous cysts, and a small parovarian cyst, 1 centimeter in diameter. Cystic oophoritis of the ovary was noted. The patient made a good recovery.

Case 4. (A350044.) Mrs. D. S., age 48 years, came to the Clinic February 17, 1921, because of nervousness and menstrual pain. In 1911, she had had a partial hysterectomy on account of "tumors" and menorrhagia. She then remained well for a few months. Her menses were regular, lasting about a week at a time, with very scant flow, and accompanied by abdominal distress and soreness. She was constipated all the time, but more so during menstruation, when much flatus was passed. She had never borne children.

Examination revealed a hard mass filling the pouch of Douglas. At operation February 23, 1921, a hæmorrhagic cyst in the left ovary, bilateral chronic salpingitis, and a mass involving the sigmoid throughout its entire thickness were found. Both tubes, ovaries, and 12 centimeters of the sigmoid were removed, and an end-to-end anastomosis made. The pathologists found that adenomyoma involved the entire thickness of the sigmoid, over an area 6 by 4 centimeters, the greatest thickness being 2.5 centimeters (Fig. 4). The mucous membrane over this area contained multiple, small, polypoid elevations. The mass contained a fibro-

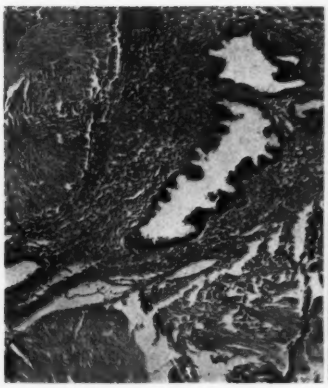

Fig. 4. Case 4. Adenomyomatous tissue from sigmoid. (x 50.)

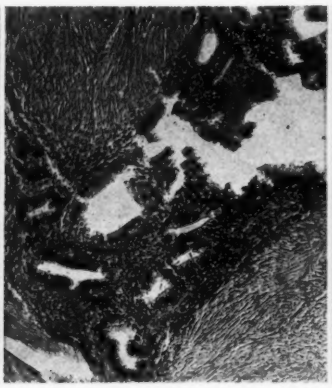

Fig. 5. Case 5. Well differentiated glands in typical stroma. (x 70.)

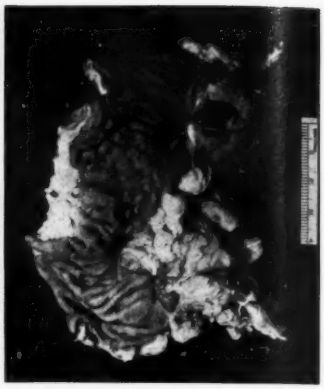

Fig. 6. Case 5. Gross specimen showing intact mucous membrane.

myoma, 5 by 4 by 4 centimeters, adherent to the serosa of the bowel. The left ovary contained a hæmorrhagic cyst, 7 centimeters in diameter, and there was bilateral chronic salpingitis. The patient now reports that she is well.

Case 5. (A415325.) Mrs. W. McK., age 45 years, came to the Clinic January 15, 1923. She had been well until 4 years before, when she began to be troubled with constipation, which was worse during menstruation and was associated with pain in the abdomen, particularly in the left lower quadrant, radiating to the back. Much flatus was passed. She had headaches and had lost her appetite. In April, 1920, she had no bowel movement for 5 days, although large doses of cathartics were taken. Pain in the lower abdomen was severe. There was some fever. A laparotomy was performed and an obstruction found in the rectosigmoidal region which was not thought to be malignant. A colostomy was made. For the first 2 months, all fæces came through the colostomy, but after that, about one-third came through the rectum, and the colostomy opening grew smaller. January 1, 1923, pain recurred, and bowel movement again became difficult. The patient had not lost weight. She had never been pregnant.

Examination revealed a small fæcal fistula at the site of the colostomy. Roentgenograms of the colon showed a filling defect in the rectosigmoidal region. Proctosigmoidoscopic examination as high as 24 to 30 centimeters did not reveal lesions in the mucous membrane. However, in the rectosigmoidal region the bowel was narrowed as if by pressure from without. At operation, January 10, a mass was found involving a loop of the small bowel, several inches of sigmoid, and the left tube and ovary. The mass felt malignant. The small intestine was separated from it, 15 centimeters of sigmoid together with the tube and ovary were removed, and an end-to-end anastomosis made. The pathologist's report was "adenomyoma with rather extensive infiltration into the wall of the sigmoid, chronic salpingitis and perisalpingitis, and a cystic oophoritis" (Fig. 5). The mucous membrane of the sigmoid was intact (Fig. 6). The patient's recovery was slow, but satisfactory.

ETIOLOGY

The etiology of adenomyomata has always been a debated question. The oldest theory is that they may have their origin in Mueller's duct inclusions. This was contested by von Recklinghausen, who claimed a mesothelial origin through the wolffian body. He admitted, however, that some of the uterine growths originate from an adult uterine mucosa, but believed that the occurrence of tumors in the broad and round ligament, and ovary, supported his theory. In 1896, Cullen definitely brought out and supported the theory that they arise in adult uterine mucosa. Pelvic inflammation has also been referred to as a causative factor. Ivanoff claimed that adenomyomata are the result of ingrowings of the peritoneal covering. Sampson has recently asserted that perforating hæmorrhagic cysts of the ovary give rise to these growths, and such cysts were found in the ovaries of all of his cases. It is noteworthy that cysts of various kinds were found in the majority of the other cases in the literature, and in our five cases. Bland-Sutton's recent work discountenances the Mueller and wolffian theories: he believes that adenomyomata originate from adult uterine mucosa. The evidence is confusing, and neither the position

nor structure of these tumors permits positive identification of their source.

DIAGNOSIS

Adenomyomata of the sigmoid, like those elsewhere, are most common between the ages of 35 and 45 years, in nulliparous women, or in those who have not borne children recently. In the 14 cases, in which age is recorded, it varies from 26 to 48 years, the average being 39 years.

A definite diagnosis is seldom made before operation. However, in most of our cases there was a history of dull pain in the lower abdomen, on the left side, associated with constipation, and which had lasted for 2 or 3 years. The pain and the constipation were definitely more severe during menstruation. At these times defæcation was often painful and in some instances associated with rectal spasm. There was seldom any loss of weight. Cachexia was not observed. Acute, or subacute, intestinal obstruction occasionally occurred; two patients in our series had had colostomies before coming to the Clinic. Physical examination revealed very little that was abnormal, except in some cases a mass in the left side of the pelvis which occasionally extended into the pouch of Douglas. Roentgen-ray examination revealed a filling defect in the sigmoidal region, but there was nothing distinctive in the picture. On proctosigmoidoscopic examination, the mucosa was found to be intact, but there was narrowing of the bowel and extraluminal pressure.

Adenomyoma of the sigmoid is usually confused with cancer of the sigmoid. It is difficult to distinguish it from early cancer before hæmorrhage, loss of weight, and cachexia occur. The longer course of the disease is evidence against malignancy. Diverticulitis of the sigmoid sometimes resembles these tumors in many ways. However, diverticulitis occurs twice as often in the male as in the female. A typical roentgenogram, when it is obtained in cases of diverticulitis, will make a definite diagnosis possible.

TREATMENT

The treatment of adenomyomata is entirely surgical. The symptoms and physical signs, although suggestive, are seldom, if ever, sufficient for a definite pre-operative diagnosis. As in other surgical conditions of the sigmoid and colon, a temporary colostomy should be made first, and an opportunity afforded for the patient to recover from obstructive symptoms that may be present. During this period, the lower loop of the bowel can be thoroughly cleansed by daily irrigations. A second operation, resecting the tumor, may then be safely undertaken; the results of such resection are usually good.

PATHOLOGY

Adenomyomata occurring in the sigmoid are similar to those occurring elsewhere in the body. They are gray, solid, and fibrous. The adenomatous portions of the tumor are glistening or dark brown (when hæmorrhagic) areas, varying in size from 1 to 2 millimeters to 1 centimeter in diameter. Microscopically, they consist of a stroma of connective tissue (of the endometrial type) and smooth muscle fibers, varying in proportion. Within this stroma there is glandular tissue or dilated spaces, lined with cylindrical epithelium, which resembles closely that of the endometrium. In certain sections there are evidences of hæmorrhages, both recent and old. Although these tumors rarely show evidence of malignancy, pathologically, and should be carefully distinguished from cancer by the regularity of the gland structure and the differentiation of the cells, they have marked infiltrative characteristics. On account of this marked tendency to infiltrate and recur, if not carefully removed, they are considered clinically malignant locally. They do not tend to metastasize.

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POSTOPERATIVE RENAL HÆMORRHAGE

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NEPHROTOMY is a conservative operation which should be free of danger, but as postoperative hæmorrhages appear in 10 to 12 per cent of the cases, it is evident that it is not quite so free from risk. Postoperative hæmorrhage may be of two kinds: primary, when it appears immediately or in 1 or 2 days after the operation, and secondary, when it appears on the sixth to twelfth day after intervention.

The pathogenesis of postoperative renal hæmorrhage is still discussed. Albarran (1) thinks that such hæmorrhages are the result of poor suture of the kidney; Rafin (16), on the contrary, believes that they are caused by the infection.

Langemak (11), de Hermann (7), Wildboltz (22), Frankel (5), de Kocher (9), Kortweld (10), and Papin and Morel (14) are of the opinion that a renal infarct is the cause of the hæmorrhage, but at the same time they state that the findings obtained from experimental investigation on dogs and hares are not always applicable to the human being. After operating on the kidney, Legueu (12) observed hæmorrhage in 16 cases and was obliged to do a nephrectomy. He made a complete examination of 12 of these cases and found the causes of the hæmorrhages to be as follows:

In 1 case the hæmorrhage was the result of the cutting of a vessel, and because of the profuse bleeding, he was obliged to do a nephrectomy the same day.

In 4 cases hæmorrhage was caused by the formation of an infarct at the site of the kidney incision. Legueu and Verliac think that suture of the kidney with catgut produces a leucocytic infiltration, an inflammatory reaction, and an anæmia which may lead to sphacelus when there is infection. To this may be added also the fact that because the anatomical disposition of the renal arteries, which are terminal, is not to produce infarcts, section must be done a little farther back on the convex edge; as this is difficult, Legueu believes that a small infarct is always the result of suture and section.

In 4 other cases, hæmorrhage appeared after pyelotomy and was again caused by an infarct as a result of the rupture of an abnormal artery. In 2 cases the hæmorrhage was also caused by an infarct as a result of the rupture of an abnormal artery after a nephrolithotomy.

The anatomopathological investigation carried out by Verliac, has proved that all the vessels which surround an infarct are congested, dilated, and most likely broken down. However, examination did not reveal rupture of any important vessels and hæmorrhage must have been from the small vessels.

In a single case only, the hæmorrhage was not caused by an infarct; the kidney presented distinct areas of nephritis and all around these foci of infection there was congestion, and the small vessels were ruptured.

Legueu says that, while infarct formation is nearly always fatal, it does not lead in all cases to serious hæmorrhage. He had an opportunity to observe an infarct which followed operation and was the result of

section of an abnormal artery, and though the patient recovered without late hæmorrhage, he thinks that in the presence of infarct and hæmorrhage, infection is the determining factor.

Rehn (18) concludes that hæmorrhage after nephrotomy is caused by circulatory disorders as the veins are distorted because after operation the kidney is left in its capsule without being fixed. To avoid this he proposes the following method of fixing the kidney: After the kidney has been returned to its capsule, with one hand the operator presses the inferior pole against the costal arc, and with the other hand sutures the kidney, using a big Hagedorn needle with thick double silk thread, traversing the skin and the muscular stratum at the inferior edge of the twelfth rib on the external edge of the sacrospinal muscle and passing through the middle of the inferior pole of the kidney which is vertical on the costal arc. The needle is then passed through the insertion of the diaphragm and comes out in the eleventh intercostal space at the superior edge of the twelfth rib. The ends of the threads are tied outside on a roll of bandage. In this way Rehn believes that it is possible to avoid hæmorrhage and even renal fistula after nephrotomy.

Rehn (19) studied this problem experimentally on dogs. In a group of experiments, he ligated the ureter without doing a nephrotomy. In all the animals he noticed a hyperæmia and hæmorrhage from congestion in the renal parenchyma. The author concludes that, after ligature of the ureter, the distention of the pelvis of the kidney produces pressure on the veins which form an acute angle, and it is necessary to consider what the effect will be of continued pressure of the urinary canaliculus and of a modification of the concentration of the urine. With the aid of the glomerulary apparatus we obtain complete cessation of the urinary secretion and it is for this reason that Rehn believes that the block pressure increases so suddenly and considerably in the arterial system. In the second group of experiments Rehn ligated the ureter in addition to doing a nephrotomy. In some cases a urinary fistula occurred and hyperæmia was not present; in others a fistula was not produced, and there was hyperæmia and serious hæmorrhage.

In the third series of experiments, (a) Rehn changed the position of the kidney after nephrotomy, and (b), in others for control, he fixed the kidney after nephrotomy. In the cases in which he changed the position of the kidney after nephrotomy all the animals died from secondary hæmorrhage, but he did not observe in any of these cases necrosis or renal infarct formation. In the other cases in which he fixed the kidney after nephrotomy, all the animals got well without the slightest hæmorrhage. From these experiments, Rehn concludes that late hæmorrhage after nephrotomy is caused by obstruction of the ureter (most often through blood clot), when the renal wound is nearly completely cicatrized.

To avoid these hæmorrhages he carefully sutures the parenchyma after each nephrotomy, fixes the kidney after his method, drains the pelvis of the kidney as well outside as in the bladder with a thick ureteral sound. He maintains that correct incision (Zondek or Marwedel) and careful suture of the parenchyma protect against primary hæmorrhage; to avoid late hæmorrhage he recommends physiological fixation of the kidney with careful drainage at the same time.

In addition to the causes mentioned, there are cases in which hæmorrhage is produced by a sectioned vessel. Perineau (15) had a case in which hæmorrhage appeared the twelfth day after nephrotomy. He immediately operated and found an arteriole in the cortical zone which was bleeding. He again sutured, placing his sutures deep and making them very tight and close together. After this the patient recovered.

Tuffier (21) published two cases in which immediate hæmorrhage was so abundant that it was necessary to ligate an artery.

Mayo-Robson (13), Sabatier (20), and Desnos (4), in cases exactly like these, have been obliged to do a nephrectomy immediately.

Rafin (17) observed a case of profuse hæmorrhage after pyelotomy, produced by the breaking down of a ligature from a severed arteriole that passed behind the pelvis of the kidney.

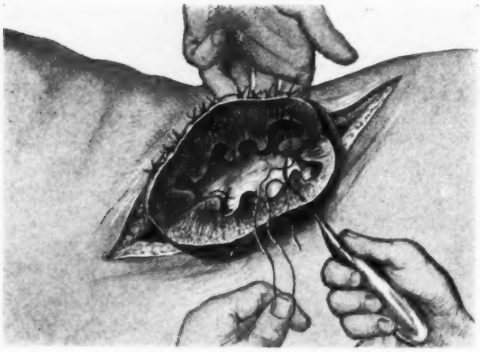

Fig. 1. Author's method of applying sutures.

Christian (2) reports a case with serious hæmorrhage after a nephrolithotomy, in which he was obliged to do a nephrectomy. The hæmorrhage was caused by the breaking-down of the eshars of the parts which were bruised during the intervention.

Zimmer (23) had a case with serious hæmorrhage after nephrotomy which necessitated immediate nephrectomy. In preparing for the operation, there was found a thick vein (1.1 centimeters) that went through all the superior part of the pelvis of the kidney, and which came in the area of the kidney incision. The author concludes that it is necessary to consider as important in making an incision in the renal parenchyma, not only the arterial distribution but also the venous circulation, for there are circumstances when the course of the large veins is of a special clinical importance.

Delbet and Mocquot (3) believe that the large veins that we cut when operating and which remain open, all help to produce hæmorrhage. To prevent hæmorrhage, Hagenbach (6) passes three sutures through the renal parenchyma. These are tied outside on small pieces of kidney fat. He believes that the sutures can be strongly tied in this way, without the danger of tearing the renal tissue.

I had the opportunity to operate in some cases of hæmorrhage after nephrotomy. In the first case a very profuse hæmorrhage endangering the patient's life appeared 6 hours after operation. I was obliged to operate a second time and found toward the superior pole of the organ a severed artery with a diameter of 1 millimeter which was the cause of this hæmorrhage. With the needle I passed a suture through the renal parenchyma. I tied the artery and the hæmorrhage stopped. The patient recovered soon after.

In another case I had to operate because of secondary hæmorrhage which appeared the sixth day and was repeated twice at the dressings. Opening the kidney I found that the hæmorrhage was coming from the veins of the renal parenchyma at the site of the drainage tube. I applied some U-shaped sutures, passing the stitches through the capsule and through the pelvis of the kidney. I tied these sutures and the hæmorrhage stopped. In the third case after a nephrolithotomy for numerous calculi of the kidney, with excessive hæmaturia, I observed immediately after the operation a rather abundant hæmorrhage, which forced me to open the renal sutures. At the site where I had taken out a calculus which was fixed in a small cavity in the renal parenchyma, was an ulcerated vessel which was causing the hæmorrhage. A circular suture that I passed through the parenchyma and tied afterward, stopped this hæmorrhage. I have observed hæmorrhage also after pyelotomy, and in these cases, there were again vessels in the coats of the pelvis which produced the hæmorrhage. Although these vessels are very small, when once tied, the hæmorrhage disappears.

Therefore I consider that primary or secondary hæmorrhage after nephrotomy is produced by cutting vessels of an organ eminently vascular, as the kidney.

Primary hæmorrhage I believe is caused by cutting the arterial branch; secondary hæmorrhage by cutting small arterioles or veins in the renal parenchyma which as a rule are at the level of the pyramid of Bertin; infection loosens the sutures, so that the thrombus which obstructs the vessel detaches itself.

To convince ourselves we proceed in the following way:

We expose the kidney and deliver it from the wound. Before incising it, we ask the assistant to press the pedicle with one hand, or we apply a forceps with elastic ends covered with rubber tube; afterward we section the renal paren-

chyma, and after thoroughly cleansing the incised surfaces of blood from the veins, we loosen the forceps gently, or we ask the assistant to release pressure on the pedicle in case he has produced hæmostasis. Thus we are able to observe immediately how the hæmorrhage comes from the sectioned vessels.

To prevent these hæmorrhages, which usually are stopped by suture of the kidney, but which reappear if infection occurs and causes loosening of the sutures, thus detaching the thrombus that obstructs the vessels, I proceed in the following way:

After delivering the kidney I apply a forceps to the pedicle or the assistant presses it. After incision and extraction of the calculus, I apply U-shaped sutures with a small Reverdin needle. The sutures pass on one side through the capsule, and on the other side through the mucous membrane of the pelvis. These sutures are usually passed at the level of the Bertin pyramids, where the cut vessels can be seen. Afterward we loosen the forceps, and look toward the superior or inferior pole, to see if there is any cut arterial branch. In case there is, we pass a suture through the parenchyma (Fig. 1).

If hæmostasis is good, only a few drops of blood that come out through the capillary vessels will be seen after the loosening of the forceps. Tightening of the sutures must be done with great care to avoid cutting the parenchyma.

In operating to remove numerous calculi which are situated in small cavities in the renal parenchyma, and which have produced abundant hæmorrhage before operation, we examine the bottom of that cavity. If we find an ulcerated vein we apply a circular suture all around the base of the cavity; we tighten this suture very gently and in this way, through compression of the parenchyma, we close the orifice of the ulcerated vessel. Afterward we suture the kidney according to the classical method and insert a drainage tube; the two ends of the threads which united the renal parenchyma near the drainage tube are passed through the muscle and tied, in this way fixing the kidney to the abdominal wall (Fig. 2).

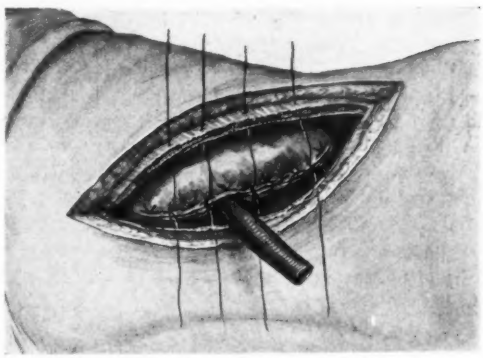

Fig. 2. Method of fixing kidney to abdominal wall.

When I began using this technique I no longer observed hæmorrhage primary or secondary. By the use of the U-shaped suture we always produce small renal infarcts but if hæmostasis is accomplished, hæmorrhage does not appear. In a case of nephrolithotomy in which I applied only two U-shaped sutures on the larger vessels, as I thought that the suture of the kidney would be sufficient to produce hæmostasis, after 8 days the patient had a violent hæmorrhage repeated twice, which necessitated a second operation. Toward the hilum I found two small arterioles which were bleeding. I applied two U-shaped sutures, applied drainage to the kidney and the patient recovered.

One might object that this method puts out of function a part of the renal substance which is between the U-shaped sutures. However, the amount of substance within the sutures is so small that it is scarcely of any importance, and we much prefer to lose a small part of the kidney, than to be obliged to do a secondary nephrectomy or to risk the life of the patient. I would advise the surgeon who does not wish to use this method of provisory hæmostasis, to use it in cases of secondary hæmorrhage after nehphrotomy, for they can be assured that the hæmorrhage will stop and it will not be necessary to do a nephrectomy.

Renal fistula heal much more quickly when this method is used. As blood clots that might decompose are no longer present in the pelvis the infection clears up more easily also. After an exploratory nephrotomy for hæmorrhagic

nephritis in cases in which it is necessary to carry out a decapsulation of the kidney, I believe the narrow strip of capsule, 3 to 4 millimeters in width, through which the sutures are passed, should be left on each side of the incision.

It is more difficult to secure hæmostasis in some cases, as in liberating the kidney the capsule has been broken, or the renal pedicle is short, the patient too fat, and the delivery of the kidney impossible.

CONCLUSIONS

We distinguish two kinds of hæmorrhages after nephrotomy:

1. Primary hæmorrhage which appears after a few hours or during the first day of the operation and is of arterial origin;

2. Secondary hæmorrhage which appears during the first 10 to 12 days after operation and is of venous or arterial origin. Concerning pathogenesis and treatment opinions differ.

a. Legueu, Papin, Morel, Langemak and Wildboltz, and others, believe that the hæmorrhages are caused by infarct formation which sometimes produces late hæmorrhages and is most probably influenced by infection.

b. Rehn believes that the hæmorrhages are the result of disturbance of circulation and secretion and recommends as a means of preventing them the physiological fixation and drainage of the kidney.

c. I affirm that hæmorrhage after nephrotomy is the result of the cutting of intrarenal vessels, and that infection causes at the same time the breaking down of the renal suture and the detachment of the clot that had been formed. To avoid these hæmorrhages I recommend that U-shaped sutures be used and passed through the cut surfaces of the kidney.

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THE PATHOLOGY AND TREATMENT OF CHRONIC LEUCORRHŒA[1]

A Further Clinical and Laboratory Study of This Subject

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In 1920 was presented a summary of my studies concerned with the pathology and bacteriology of chronic leucorrhœa,[2] together with a report of the therapeutic results obtained in 46 most recently treated patients. In contrast with previous experience, the results which had been obtained in that small series of cases were most encouraging, not only because of recovery of the patients, but especially in view of the fact that the treatment was based upon investigations concerned with the sources and nature of discharges and the pathological changes encountered in the tissues. It is desired, at this time, to report further experience in this work.

PATHOLOGY AND BACTERIOLOGY ASSOCIATED WITH LEUCORRHŒA

As previously recorded,[3] histological examination and bacteriological cultures of the entire ground endometrium, above the level of the internal os, rarely revealed evidence of infection in a study of uteri removed to remedy various pathological conditions. It appears that there is now general acceptance of the view that chronic infection of the body of the uterus is unusual; in the foremost clinics employment of the curette in attempts to relieve infection is considered a misdirected and harmful procedure.

In contrast, the cervix is believed to be an important focus of infection and the chief source of chronic leucorrhœal discharges. The pathology responsible for these discharges consists of redundant hypersecreting glandular tissue, often associated with insufficient drainage of the secretion (Fig. 1.).

The frequency and importance of cervical granulations and strictures requires further emphasis. Just as appendicitis formerly remained unrecognized and duodenal ulcer existed unnoted, these cervical lesions have usually been overlooked and, when recognized, their significance has been underestimated.

Further histological study of cervical tissues obtained from our service at St. Luke's Hospital confirms previous evidence in which most patients with chronic cervical leucorrhœa revealed cervical infection. There are, however, important exceptions to this; continued discharge may persist after disappearance of infection, provided there is extensive hyperplasia of gland tissue or partial obstruction of the cervical canal which interferes with drainage. In the event of disappearance of bacteria from the tissues, the cervix is no longer a focus responsible for ill health, other than that incident to mechanical annoyance from innocent discharge.

Bacteriological study of the endocervix does not closely parallel histological evidence. The tough sclerotic tissues are ground only with great difficulty and are not adapted to satisfactory bacteriological investigation. Scattered colonies of diphtheroid bacilli, bacilli of the colon group, some staphylococci, and varied anaerobes are encountered. From the standpoint of stubbornness of infection, gram-positive diplococci are most important. Examination of discharges, both in fresh preparations and in cultures, reveals that these bacteria, either aerobic or anaerobic, are found in notable numbers in about one-third of all patients with purulent leucorrhœa; they appear to be the chief cause of otherwise inexplicable puerperal infection which develops in patients with leucorrhœa.

Many a patient with profuse leucorrhœa of years' standing has no lesion other than persistent discharge from a sacculated Skene's duct opening in the floor of the urethral meatus. Usually the other Skene's duct is somewhat infected. Slightly higher in the urethra,

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[1] Read before the American Gynecological Society, Hot Springs, Virginia, May 21–23, 1923.

the small urethral glands occasionally harbor infection, and pus can sometimes be seen exuding from a minute opening upon exerting suburethral pressure.

Some patients reveal no infection in the region of the urethra and examination indicates an essentially healthy cervix, yet leucorrhœa persists. It has never been evident that disease of the Bartholin glands or erosions implanted upon the vaginal walls can account for these cases. Heavy congested pelvic organs or deep-seated pelvic infection are assumed to be the underlying lesions in most instances, but accurate determination of the pathological process is often impossible.

METHOD OF TREATMENT AND RESULTS

Our treatment of chronic leucorrhœa previous to 1919 yielded distinctly disappointing results. Since that time 140 patients, including 46 previously reported, have been treated. This number does not include a very considerable group in whom office management has been sufficient to effect relief. Only the most severe and most chronic cases, all subjected to a trip to the hospital, are here considered.

The patient is given nitrous oxide anæsthesia. The vicinity of the urethra is searched for infected Skene's ducts and urethral glands. Diseased foci are threaded on the blunt end of a needle, the tract laid open with a knife, and lining fulgurated or otherwise cauterized.

Examination of the Bartholin glands and vaginal walls seldom indicates that these tissues participate in the disease process, although occasional discharging sinuses are traceable to an origin in the Bartholin glands.

Upper zone pelvic lesions, requiring surgical intervention, do not concern us at this time.

Cure of the diseased cervix may be achieved through radium application, which produces atrophy of the infected glands, or through removal of the endocervix. Surgical removal, according to the method of Sturmdorf, has yielded excellent results in those selected cases in which it has been employed. In our work, radium is given preference in patients with evidence of infection extending high into the cervical canal, in those with strictures in the vicinity of the internal os, in patients with profuse creamy discharge, in those whose cervix is inaccessible to surgery, and in instances where removal of the diseased tissues promises to require extensive or difficult operation. Wedge-shaped excision of the anterior lip, or other simply performed removal of diseased tissue, is often combined with the radium application. The fundamental requirement is that the patient be relieved of the diseased, discharge-producing tissues; further experience will best determine whether a given patient shall be treated with radium or subjected to removal of the endocervix.

The technique of radium treatment is as follows: The cervical canal is investigated with graduated dilators. Thorough dilation is made without producing laceration. Diagnostic curettage, separate for cervix and fundus, may be desired. Two 25 mg. tubes of radium, in tandem, are introduced into cervix and held in position by Michel clip at external os. The screen now used is a rubber-covered gold capsule, 0.5 millimeter in thickness. Younger women, with regular menstruation, receive application for 7 hours; treatment for this period of time never disturbs the normal menstruation. Patients over 35 years of age must be treated with greater caution.

The immediate result of radium treatment is increased discharge, which persists for many weeks. This stage is often followed by a stationary period of a month, or even 2 months. Meantime, the cervix should be dilated occasionally, at office, to prevent stenosis.

Gradual improvement is the rule; recovery after a single application is frequent, but a considerable number require a second radium treatment to effect a thorough cure. This is preferably postponed for several months, first, because one treatment may eventually prove to be sufficient, second, because it is desired to ascertain with certainty that radium has not interfered with the menstrual function. The dosage of the second application varies with requirements, but may almost always equal the amount first used, if desired. At this time attention should again be directed to Skene's ducts, which may not have been completely destroyed at the first treatment.

It should be particularly emphasized that several patients with long-standing leucor

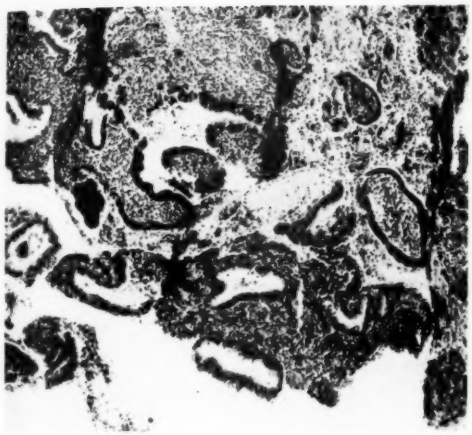

Fig. 1. Endocervix from patient with chronic leucorrhœa; showing overgrowth of infected hypersecreting glands.

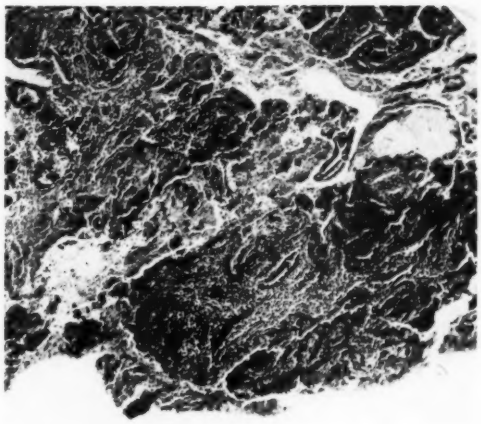

Fig. 2. Endocervix after recovery from chronic leucorrhœa. Radium has produced almost complete atrophy of the infected cervical glands.

rhœa, in whom the results of treatment appeared unsatisfactory, upon return 9 months or 1 year later revealed absolute recovery from their affliction. It is always advisable to state that the curative effect of the radium may not be manifest until this period of time has elapsed.

A total of 126 patients have been treated, but 22 of these have not been available for further study. Ninety patients have recovered (Fig. 2), seven are improved, and seven have not been benefited.

Of the 90 patients classed as "recovered," 6, after a normal course of one-half year or more, came back with history and evidence of freshly acquired infection. One of the chief difficulties in treating this affection is that the patient is often subjected to further exposure to disease or undergoes sexual trauma during the period of convalescence.

The 7 improved patients include 4 whose treatment has been interrupted or incomplete; no late report is available from 1; 2 will probably remain stationary.

Seven unimproved merit individual attention: (1) A patient with profuse creamy streptococcus-laden discharge revealed a widely open cervix, a fundus retroposed, slightly held by adhesions and containing a 4 centimeter fibroid, all pelvic tissues boggy and inflamed. Complete hysterectomy, after failure with other treatment, was followed by recovery. (2) A patient with considerable thin creamy discharge, unimproved after 2 years, gradually recovered after hysterectomy of a uterus which revealed slight evidence of diffuse cervicitis and metritis. (3) Leucorrhœa from a cervix left after removal of infected tubes, ovaries, and fundus, failed to yield to radium treatment. The discharge now persists 6 months subsequent to complete removal of the cervix. (4) A prostitute, who showed early signs of improvement, reports often for treatment, but subjects herself to renewed infection. Three other patients, two of whom show signs of pelvic cellulitis, have not been benefited by treatment.

COMMENT

Characteristic of chronic cervical disease is the symptom of leucorrhœa. Associated arthritis and general ill health are a frequent result; much more frequent than many have believed. The notable improvement in health and spirits of many who have recovered from chronic leucorrhœa has particularly impressed me with the importance of these low-grade infections.

The writer, in a recent study of diseased fallopian tubes, found that a single gonor-

rhœal infection of the tubes is of short duration. So-called chronic gonorrhœal salpingitis seems not to be a persistent infection but rather a recurrent process, in consequence of repeated ascent of gonococci from the lower genital tract or from an outside source. Streptococci, on the other hand, may remain viable in the tubes for many years. These observations are of interest in the present problem, for a study of chronic discharges reveals that gram-positive diplococci, which produce rich growth of streptococci in cultures, are characteristic of the most severe and most chronic leucorrhœal infections. In other words, it would appear that certain cases of leucorrhœa owe their resistance to treatment to the fact that streptococci invade the inaccessible cellular tissues of the pelvis and are capable of remaining viable for an indefinite period of time.

Another class of patients in whom either radium or endocervical excision offer only moderate prospect of relief are those with heavy displaced pelvic organs. Especially in the presence of a widely open cervical canal, procedures short of radical surgery fail to bring about recovery.

CONCLUSIONS

1. The sources of chronic purulent leucorrhœa can usually be definitely localized. These foci of infection are important factors in the production of systemic disturbances, as well as local distress.

2. Cervical discharges may persist after disappearance of infection; this is notably true if extensive hyperplasia of the cervical glands has occurred. Relief from these innocent discharges is not essential, provided they cause no mechanical annoyance.

3. Available measures in the control of chronic leucorrhœa consist in eradication of gland infection in the vicinity of the urethra, dilatation of cervical strictures, and destruction of hyperplastic glandular tissues of the cervix. Whether the latter is to be accomplished by endocervix removal or through the use of radium should depend upon the character of the pathology encountered, modified by the experience of the surgeon in charge.

4. Destruction of infected Skene's ducts and urethral glands, together with thorough dilatation and radium treatment of the cervix, has been followed by recovery from chronic leucorrhœa in 87 per cent of 104 patients.

BREECH PRESENTATIONS TREATED BY PROPHYLACTIC EXTERNAL VERSION

Report of Fifty-Nine Breech Presentations so Treated

By GEORGE HOPE RYDER, M.D., New York

BREECH presentations are always a source of worry to the obstetrician and a danger to the unborn child. The fetal mortality in breech presentations is much higher than in cephalic presentations. According to the standard textbooks on obstetrics, the fetal mortality following unconverted breech presentations ranges from 20 per cent to about 6 per cent, or from 1 in 5 to 1 in 16.

Thus Hirst, of Philadelphia, in his *Textbook on Obstetrics*, says: "The fetal mortality of breech presentations is about 20 per cent, including badly managed cases in general practice."

Williams, of Baltimore, in his *Obstetrics*, says: "The prognosis for the child is considerably worse than in vertex presentations, the fetal mortality being generally estimated at 10 or 15 per cent."

Peterson, of Ann Arbor, in *The Practice of Obstetrics*, says: "Ten per cent of the children are lost in primiparous women. Asphyxia is the cause of death. In multiparæ, however, the prognosis is about a third as bad. Some authorities, however, estimate the general fetal mortality as high as 20 per cent (Edgar)."

The *American Textbook of Obstetrics:* "The prognosis for the child is always poor, the mortality running as high as 10 per cent in skilled hands."

Cragin, of New York, in his *Practice of Ob-*

stetrics, states: "In a series of 835 breech presentations at the Sloane Hospital, in the first 20,000 deliveries, there was a complete fetal mortality, including abortions and macerated fetuses, of 302, or 36 per cent; of fetal deaths from the labor itself, however, there was less than 6 per cent." (The latter part of this statement is inaccurate, the corrected mortality making this last figure nearer 8⅓ per cent.)

Polak, of Brooklyn, in his *Manual of Obstetrics*, says: "The mortality to the child, when the delivery is left to nature, is 10 per cent, at least in first labors; with skilled management, it is but little greater than in vertex births."

Potter, of Buffalo, the greatest exponent of internal version and breech delivery in this country, is reported to have said recently to a member of the Sloane Alumni Society, that his fetal mortality from breech deliveries following breech presentations, was 9 per cent in primiparæ.

Most of the authorities mention external version as a desirable prophylactic measure.

Polak says: "External version is permissible if it can be done without violence."

Hirst says: "Before labor, external version may be attempted. It will not always be found practicable, and after the fetal body has been turned, there is a disposition on the part of the fetus to resume its original position. The application of two long cylindrical compresses to the sides of the uterus, and a firm abdominal binder, may prevent a return of the breech presentation. When labor has begun, inaction should be the physician's policy. . . . "

Cragin says: " . . . it is usually wise to attempt the conversion of the breech to a vertex presentation before labor. . . . In multigravidæ with lax abdominal and uterine walls this conversion can often be accomplished with ease by external version. . . . If the patient is a primigravida, with tense or very fat abdominal wall, or if the fetus is very large and the breech is low in the pelvis, external cephalic version is much more difficult, and sometimes without an anæsthetic is impossible. Under an anæsthetic, the version is usually easy, and the difficulty consists only in maintaining the corrected presentation. If the head is placed well within the brim of the pelvis, and there is no abnormality present, the fetus will often stay in cephalic presentation. Disappointments, however, are not uncommon. . . . The corrected presentation can sometimes be maintained by an abdominal binder, but occasionally all efforts in this direction fail and the presentation is best left as a breech."

TABLE 1.—BREECH PRESENTATIONS

Total number consecutive deliveries	890	
Total number breech presentations	59	1 to 15
Primiparæ	24	40.6%
Multiparæ	35	59.3%
Viable fetuses	52	88.1%
Non-viable fetuses (all under 7 months, 2 macerated)	7	11.9%

Williams says: "In view of the serious fetal prognosis attending breech presentations, the obstetrician should aim to prevent their occurrence as far as possible, and whenever they are diagnosed, in the later weeks of pregnancy, an attempt should be made to substitute a vertex presentation by means of external version. This is readily accomplished in multiparæ with lax abdominal walls, but is much more difficult in primiparæ. If there is no serious disproportion and the head can be forced into the pelvis, after the substitution has been effected, the new position becomes permanent, but if engagement fails to occur the child will usually revert to its original position, notwithstanding the application of a properly fitting bandage. In the former case the result is usually excellent, and affords striking proof of the value of routine antepartum examination. External version may also be attempted in the first stage of labor, provided the breech has not descended deeply into the pelvis; but when it has once become fixed, all such efforts are unavailing, and it is best to leave the case to nature, and be prepared to interfere when necessary."

Realizing the dangers of breech deliveries, even in normal pelves, the writer has for years followed the plan of converting all breech presentations, when practicable, into vertex presentations, by external version. Under this plan of treatment, the following series of breech presentations is offered.

In 890 consecutive deliveries in private practice, there were found 59 breech presentations, approximately occurring in the proportion of 1 to 15. Twenty-four of these were in primiparæ, and 35 were in multiparæ. These 59 breech presentations naturally fall into three groups when treatment and results are considered.

1. *The non-viable.* Of these there were 7. Spontaneous delivery took place before the seventh calender month, or more than 8 weeks from term. Two in addition were macerated. Under no method of delivery could any of these be saved; presentation was of no significance; and no attempt was made to change the presentations, either at the time of labor or previously.

TABLE II.—TREATMENT

Non-viable, no attempt at treatment, 7 cases
Viable under observation before labor, 49 cases

	External version	Failure at attempt at version	No attempt at version	Total
Normal	20	0	0	20
Forceps	7	0	0	7
Breech	1	1	16	18
Cæsarean section	1	3	0	4
Total	29	4	16	49
Version with anæsthesia	6	0		
Without anæsthesia	23	0		
Fetus living	29	0	0	
Fetus dead	0	0	0	

Viable, not under observation before labor, 3 cases

	External version	Left as breech	Total
Forceps	1	0	..
Breech	0	2	..
Total	1	2	3
Version with anæsthesia			1
Fetus living			1
Fetus dead			2

2. *The viable under observation before labor.* There were 49 of these, delivery taking place within 8 weeks of term.

3. *The viable not under observation before labor.* These were 3, delivery taking place within a few weeks of term, but none of them having been seen before labor.

Obviously, it is in the management of the second group, that of viable fetuses under observation before labor, that most should be expected from prophylactic treatment by external version; for, in the first group, the non-viable, it was too early for such treatment; and in the last, the viable not under observation before labor, it was mostly too late. It is to the second group, therefore, that special attention is directed.

The management of these 59 breech presentations (in the various groups) was as follows:

For the first group, the non-viable, there was no treatment, or attempt at treatment, as mentioned.

The method of treatment of the second group, the 49 viable fetuses under observation before labor, was the following: External version was performed on 29 of the 49 patients—considerably more than half. After the 29 external versions, deliveries were as follows: 20 were delivered normally, 7 were delivered by forceps, 1 was delivered by the breech, after spontaneous reversion, 1 was delivered by cæsarean section. This patient had a small pelvis and external version was performed at the seventh month. During the next 2 months, the head did not settle down into the pelvis, but remained high. Moreover, it could not be crowded down into the pelvis. At operation, a marked projection of the promontory of the sacrum was found, which would have made natural labor impossible. It was felt that, in this patient, disproportion of the head and pelvis could not have been so easily made out, if the presentation had remained a breech. This seems to the writer to be one distinct advantage of early external version.

After these 29 external versions, then, there were 20 normal deliveries, 7 forceps deliveries, 1 breech delivery, and 1 cæsarean section. All of these 29 fetuses lived.

On 4 women of this same group, external version was tried and failed. Three were elderly primiparæ near the age of 40. These 3 were delivered by cæsarean section. The fourth was a young primipara later delivered as a breech. These 4 fetuses lived.

In the remaining 16 patients of this group, no attempt at external version was made, delivery in all of them being by the breech. The reason why external version was not tried, will be seen. In 5, labor started prematurely, before an attempt at external version was decided upon; in 4, 4 weeks from term, and in 1, 2 weeks from term, the day after the patient returned from the country. Eight were one of twins, where external version was contra-indicated. Three were multiparæ at term, 2 with spontaneous version

TABLE III.—MONTH OF EXTERNAL VERSION

	Sixth	Seventh	Eighth	Ninth	Total
Primiparæ	0	2	3	3	8
Multiparæ	3	8	9	2	22
Total	3	10	12	5	30

TABLE IV.—COMPARISON OF MULTIPARÆ AND PRIMIPARÆ

	Multiparæ	Primiparæ	Total
Non-viable	5	2	7
Viable			
External version	21	9	30
Failure of attempt at version	0	4	4
No attempt at version	9	9	18
Total viable	30	22	52
Method of delivery			
Normal	17	3	20
Forceps	3	5	8
Breech	10	10	20
Cæsarean section	0	4	4
Total	30	22	52

vertex to breech in the first stage of labor; and 1 a lateral placenta prævia, left as breech for safety. These 16 fetuses lived.

Of this whole group, then, 49 viable fetuses under observation before labor, there was no fetal mortality.

Of the third group, composed of 3 viable fetuses not under observation before labor, all were seen for the first time in consultation.

The first patient was a young primipara in the first stage of labor, with poor pains and with the breech still high. Under ether this was turned to a vertex. Several hours later, chiefly because of inertia, delivery was made by forceps. The child was in good condition and lived.

The second patient was an elderly primipara, neglected, 2 weeks past the estimated date of confinement, already in labor 36 hours with ruptured membranes when first seen. Cæsarean section and external version were both out of the question because of the long dry labor and the many vaginal examinations. Delivery was accomplished only after a craniotomy on the after-coming head of a dead fetus.

The last patient of the three had a complete placenta prævia, and was seen for the first time after a furious hæmorrhage a few weeks before term. She was an elderly multipara just starting in labor. Delivery was effected a few hours later by an easy breech extraction, without harm to the mother, but with a dead fetus. Death seemed to be due to the placenta prævia, not to any dystocia.

Thus it will be observed that in the whole series of 59 breech presentations treated by prophylactic external version, where possible and feasible, the only fetuses lost were the non-viable and two not under observation before labor. Conversely, there were saved of viable fetuses, all under observation before labor and one of the three not under observation before labor.

To summarize:		
Total series of breech presentations	59	
Fetuses lost—all causes		
Non-viable	7	
Viable	2	
Total	9	15.2 per cent
Total number of viable fetuses	52	
Viable fetuses lost	2	3.8 per cent
Total number of viable fetuses under observation before labor	49	
Fetuses lost	0	

Of all the 30 women on whom external version was performed, in none of the primiparæ did the fetus turn back to its original presentation. In several of the multiparæ this did happen, but all were easily returned to the vertex except two.

TABLE V.—FULL TERM BREECH DELIVERIES (EXCLUSIVE OF TWINS)

Multiparæ	5
Primiparæ	3
Total	8

In one, the fetus returned to the breech presentation in the first stage of labor, and the patient was not seen till labor was too far advanced for a reposition. This patient had a slightly flat pelvis, and previous to labor external version had been performed several times, each time the fetus returning to a breech.

In the other multipara, external version was performed four times, the fetus returning each time. Finally in the first stage of labor, under ether the fetus was turned to a vertex and held there until the membranes were artifically ruptured. Normal labor followed in a few moments, after the patient came out of ether.

Twenty-three of these external versions were performed without anæsthetic. Seven were performed under ether, 3 in primiparæ and 4 in multiparæ. All the versions were performed before labor except two, one in a primipara and one in a multipara, each in the first stage, under ether, in the ninth month.

By far the greater number of versions were done in the seventh and eighth calendar months. Thus in the sixth month there were 3 in multiparæ without ether. In the seventh month there were 2 in primiparæ and 8 in multiparæ, all without ether. In the eighth month there were 3 in primiparæ without ether, and 9 in multiparæ, 3 with and 6 without ether. In the ninth month there were 3 in primiparæ, all with ether, and 2 in multiparæ, 1 with and 1 without ether. In other words, 22 out of the 30 versions were performed in the seventh and eighth months, with 3 in the sixth and 5 in the ninth.

There was no maternal mortality in the series and in no case, with one possible exception, did the external version seem to do the slightest injury to the mother. The exception was one woman in whom bleeding from the vagina was seen following the version. This did no further harm, however. Labor started promptly, was short and natural, and mother and child were entirely normal at its conclusion. The bleeding was probably due to undue force in doing the version, because of poor relaxation from a difficult anæsthesia, and probably came from pressure on the edge of the placenta.

In doing the version, it is found necessary to have the patient's bladder empty. If the breech can first be pushed up from the pelvic brim, the rest of the version is usually easy. To this end,

it may be useful to have the patient assume the knee-chest position, just before the attempt at external version is made.

No mechanical appliances were used to retain the fetus in its corrected presentation, as it was not thought that these would be of any value.

The 8 forceps operations following the 30 external versions were 2 high, 1 medium, and 5 low. None of these was difficult.

There were 4 cæsarean sections in the series. 1 after external version and 3 after external version failed. External version failed in 4 of 34 patients on whom it was tried.

Because of external versions, in the whole series of 59 breech presentations, there were, excluding twins, only 8 full term breech deliveries; 3 in primiparæ and 5 in multiparæ. Excluding those seen in consultation there were only 6; 2 in primiparæ and 4 in multiparæ.

The cord was found once around the neck of 5 fetuses delivered as vertex after external version; also of 1 fetus delivered as a breech without external version. In no instance did the cord thus around the neck do the fetus any harm.

CONCLUSIONS

The safest method of treating breech presentations is by prophylactic external version.

External version not only reduces the fetal mortality, but renders labor shorter and more natural for the mother.

The operation is safe, if done without force.

The best time for performing external version is usually the seventh and eighth calendar months.

The operation is generally quite easy and may usually be performed without ether.

When at all difficult, a general anæsthetic should be used. Under this, in most cases, except late in labor, external version is easily performed.

Force should never be used. If version can not be accomplished without force, the operation should be given up.

When external version is once performed, the fetus occasionally resumes its original presentation, but usually does not. This is more likely to occur when the version is very easy. Consequently, the fetus may be re-turned as frequently as necessary, even early in labor. When external version is difficult, spontaneous reversion is not apt to occur.

External version performed early gives warning of disproportion between the head and the pelvis, by observation of the way in which the head settles into the pelvis or may be crowded in by the obstetrician.

Finally with careful observation in the latter months of pregnancy, external version should reduce the fetal mortality of breech presentations approximately to that of cephalic presentations; and furnishes one more argument for careful antepartum examinations.

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RETROPERITONEAL OPERATION FOR SUBPHRENIC ABSCESS

With the Report of Two Cases

By CARL NATHER, M.D., Vienna, and E. W. ALTON OCHSNER, A.B., M.D., Chicago
From the Surgical Clinic of the University of Zürich, Switzerland. Professor Clairmont, Director

Up to the present time subphrenic abscess has been a very much feared complication in the field of abdominal surgery. The diagnosis and the treatment are usually most difficult.

Barlow (1) in England (1845) and Leyden (2) in Germany (1886) were the first to describe the clinical picture of subphrenic pyopneumothorax and were the first to distinguish it from the diseases of the thorax. Their clinical description is as follows: Above the liver dullness is found a tympanitic zone which in turn is covered by a zone of dullness produced by a pleural exudate. The tympany results from free gas in the peritoneal cavity which is found in only about one-third of cases with abscesses in the subphrenic region. This classical picture represents only the minority of cases and when present is not infallible, because as Beclère (3) in France (1899) has shown the tympanitic zone can be produced by a highly situated, gas-distended, transverse colon.

In those cases of subphrenic abscess where the gas is absent, the diagnosis is still more difficult because an increase in the liver dullness upward, produced by the presence of a collection of pus above the liver, is easily confused with a pleural exudate. This is especially true in those frequent cases in which a pleural exudate co-exists.

There are other cases in which the abscess is located below the liver instead of upon its upper surface, which are even more difficult to diagnose because the increased liver dullness is lacking.

ANATOMY

To understand the sites of election of secondary subphrenic abscesses, it is imperative that one be well acquainted with the topographical anatomy of the upper abdomen.

Martinet (7) (1898) and Piquands (11) (1909) in France and Barnard (2) (1908) in England have especially worked out the topographical anatomy of the subphrenic region. Martinet (7) divided this region into six spaces: two interhepatodiaphragmatic spaces located between the upper surface of the liver and the diaphragm, one on each side of the midline, a subhepatic space located on the under surface of the liver to the right of the hepatoduodenal ligament, an interhepatogastric space located beneath the liver and anterior to the lesser omentum, a retrogastric space located posterior to the lesser omentum and a perisplenic space located around the spleen.

The classification according to Barnard (2) is similar to that of Martinet (7). He described on the right side an anterior subphrenic space located between the liver and diaphragm and a posterior subphrenic space in the subhepatic pouch on the under surface of the liver; on the left side a perigastric anterior to the lesser omentum, a perisplenic and a space in the "small sac of the peritoneum."

On account of the confusing terms existing in the literature and the overlapping of the various spaces described, one of us has worked out the following anatomical classification which is described in detail in a previous publication (Figs. 1, 2, 3).

According to this classification the various spaces represent the sites in the upper abdomen where a secondary abscess may develop and each space is purposely so named so that its name describes its location. By the subphrenic region is meant that space located between the diaphragm above and the transverse colon and the transverse mesocolon below (Fig. 1), which is divided by the liver into an upper and lower space and by the falciform ligament into a right and left (Fig. 2). These four main spaces are subdivided as follows:

a. There remains a small, yet very important, space: *the right upper posterior space*,

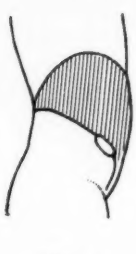

Fig. 1.

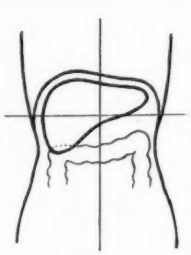

Fig. 2.

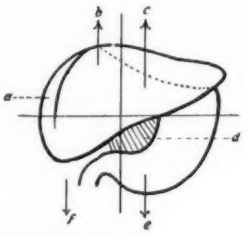

Fig. 3.

Fig. 1. Schematic lateral section showing the diaphragm above and the transverse mesocolon below as boundaries of the surgical subphrenic region.

Fig. 2. Schematic anteroposterior section showing the division of the suphrenic region into the four main spaces.

Fig. 3. Schematic representation of the spaces in the subphrenic region. The transverse line on the upper surface of the liver, which on the right side lies partly anteriorly (solid line), and on the left side lies posteriorly (dotted line), represents the coronary ligament. The right extremity of the coronary ligament (solid line) is the triangular ligament which divides the right upper space into a large anterior and a small posterior space. *a*. Right upper posterior space; *b*, right upper anterior space; *c*, left upper space; *d*, left lower posterior space (lesser peritoneal cavity); *e*, left lower anterior space; *f*, right lower space.

located on the posterior lateral surface of the liver between it and the diaphragm, which will be especially considered in this paper as we wish to deal only with those subphrenic abscesses complicating appendicitis.

b. *Right upper anterior space* located between the upper liver surface and the diaphragm anterior to the right triangular ligament.

c. *Left upper space* located between the liver and diaphragm on the left side.

d. *Left lower posterior space* which is the lesser peritoneal cavity.

e. *Left lower anterior space* beneath the liver and anterior to the lesser omentum and stomach.

f. *Right lower space* located on the under surface of the liver to the right of the lesser peritoneal cavity.

g. Perisplenic space in the region around the spleen.

Experience shows that the subphrenic abscesses complicating appendicitis are as a rule located in the *right lower* or the *right upper posterior space* or *both*.

ROUTES OF INFECTION

There are three possible ways in which the infection arising in the appendix may proceed to the subphrenic space.

1. Intraperitoneally along the ascending colon up to the liver, resulting in abscesses located intraperitoneally. These constitute about 50 per cent of the cases. (Nather, 9.)

2. The infection ascends posterior to the ascending colon in the loose retroperitoneal connective tissue, past the kidney up to the liver. These abscesses lie retroperitoneally.

3. Pyelophlebitis with origin in the mesenteric veins, resulting in a liver abscess and later perforation of the liver abscess into the perihepatic spaces.

DIAGNOSIS

The diagnosis of a subphrenic abscess following appendicitis is easy, if one bears in mind the possibility of its development and is on the lookout for the appearance of a pathological process in the spaces mentioned.

To consider the possible occurrence of a subphrenic abscess in a case of appendicitis, the postoperative course of which deviates from the normal is often equivalent to the making of the diagnosis.

As a complication after appendectomy a subphrenic abscess can develop within a few days or it may be weeks after the operation that the first symptoms appear. As a rule the abscess is, within 1 to 2 weeks, so far advanced that it can be easily recognized.

Even at the original operation, it is often possible from the findings to predict the probable development of a subphrenic abscess, i.e., a highly located, badly infected appendix; retrocæcal or appendiceal abscess; early peritonitis, etc.

When such an abscess develops the *general* symptoms are the first to be observed. The patient does not recover after the appendectomy. The temperature does not fall as should be expected, or increases without an apparent cause after an afebrile period. There may be an alteration in the pulse-rate without a perceptible temperature change. It does not decrease as it normally should or it may even increase in frequency. Leucocyte count remains high and may go still higher. The patient has no appetite. Sweating is profuse. Prostration becomes marked. The patient occasionally complains of transitory pains in the upper abdomen or chest.

Superficial examination reveals nothing. Exact, careful palpation of the subphrenic region, flank, and chest reveals finally a distinct painful point upon pressure. This may at first seem very unimportant, but it not only remains constant from day to day but increases in size. The localization at repeated examinations remains the same. One is very apt to notice that the impression made by the finger remains in the skin, a skin œdema which is often present. Later the lower lung boundary is found to be immobile. A swelling is not demonstrable either visibly or by palpation. There is dullness over the base of the right lung which is often incorrectly interpreted as the result of the bedridden condition of the patient.

This is the early clinical picture of a subphrenic abscess complicating appendicitis, the single symptoms in themselves seemingly harmless and unimportant, but which considered as a whole constitute a syndrome by means of which it is easy to make a diagnosis.

When there is not the history of a previous appendicitis the diagnosis is naturally more difficult, but even then it can usually be easily made if the case is carefully observed and the above mentioned symptoms and signs made out. Exploratory aspiration is usually unnecessary.

In those few cases in which a diagnosis can not be reached clinically, an exploratory aspiration, as advocated by Beck, must be resorted to. This, however, as with the operation, should not be carried out transpleuraly but should be performed beneath the pleura and diaphragm. The aspirating needle attached to a glass syringe is inserted in the posterior axillary line at the level of the first lumbar spinous process and is directed upward and backward at an angle of less than 45 degrees. Aspiration should be carried out by the insertion of the needle so as to prevent the danger of passing through an abscess and infecting healthy tissues beyond. One should not be satisfied if pus is not obtained by the first attempt, but should try several different directions.

If the symptoms and signs are marked as in the more advanced cases as shown by our Case 2, the diagnosis is easy. But it is essential not to wait until the case presents an advanced clinical picture, as then the patient's resistance is so lowered that the chances of recovery are much less.

REPORT OF CASES

CASE 1. Karl S., age 49, teamster, complained chiefly of pain in abdomen. The family history was negative. The patient had had no diseases in childhood. In 1912 he suffered an attack of hæmatemesis, and was in bed 3 weeks. In 1916 again he had an attack of hæmatemesis but to a lesser degree. Since then he has had no gastric symptoms. He had pneumonia in 1920.

Present illness. October 14, 1922, after the evening meal, patient experienced suddenly a sharp lancinating pain in the right abdomen. No vomiting. A doctor who was called diagnosed gastro-enteritis. On the following day, patient felt no pain when lying quietly but every bodily movement was painful. October 16, the severe sharp pain in the right abdomen again appeared. Patient felt feverish. He was sent into the medical clinic of the Kantonsspital for treatment. On the medical service a subacute perforation of a gastric ulcer was suspected and patient was transferred to the surgical service.

Physical examination. Well-developed, well-nourished adult male lying quietly in bed. It can be easily noticed that patient seemingly purposely avoids all movements. The sclera is clear, the pupils regular and react to light and accommodation. The ears and nose are negative. The tongue is moist, covered with a heavy coat. The pharynx is negative. The teeth are in poor condition. The neck is negative. The thorax is narrow and breathing is costal only. There is a percussion note res-

onant throughout the lungs. Breath sounds are vesicular. The spoken voice is normal. No râles are present. Cardiac dullness not enlarged. Heart sounds are clear, no murmurs. Pulse is 108, well filled, regular in force and rhythm. The abdomen is distended with most marked distention in the right lower quadrant. By breathing, the entire abdomen remains stationary. There is a resistance of the entire abdominal musculature upon palpation which is most marked over the ileocæcal region where a marked tenderness is also present. The abdomen is tympanitic throughout, especially in the right lower quadrant. Liver dullness is normal. In the right flank there is a definite dullness which does not move with change of position. Rectal examination shows the sphincter atonic, the ampulla dilated, no protrusion or tenderness in the cul-de-sac of Douglas. Examination of the extremities is negative. The urine is negative for albumin and sugar and there is no sediment. Temperature, 38.5° C. White blood count, 8,750. Diagnosis: (1) acute appendicitis; (2) subacute perforation of a gastric ulcer (?)

October 8. Under conservative treatment (rest in bed, ice bag to abdomen) the temperature has fallen to normal. The extensive resistance has disappeared. There is still a slight resistance in the ileocæcal region.

October 12. Temperature 37.4° C; pulse, 86; white blood count 8,400. Over Poupart's ligament is a slightly tender resistance. Rectal examination shows slight infiltration in the upper right ampulla wall. Continuous warm irrigation by means of the Arzberger tube.

October 17. Temperature normal; pulse, 86; white blood count 6,600. The resistance over Poupart's ligament has almost completely disappeared. The infiltration in the rectum is less marked.

October 25. Examination of the abdomen and rectum reveals practically nothing abnormal. Patient complains of no pain.

November 7. Patient is out of bed, feels fine. Gastro-intestinal X-ray examination shows a slight perigastritis. No ulcer niche nor signs of a previous perforation demonstrable. Stool examination for blood repeatedly negative.

November 9. Afternoon temperature 3.6° C; pulse, 80. Patient says he does not feel well but does not complain of any definite symptom. Examination reveals nothing abnormal.

November 14. Patient complains of pain in the right chest aggravated by breathing. Examination shows pleuritic rub at the base of the right lung posteriorly. No sign of an exudate. Temperature 37.8° C; pulse, 88. Iodine application and electric pad to chest.

November 17. Pleuritic rub still present and in addition signs of a pleural exudate have developed. Because of a right side pleurisy following a probable appendicitis, a subphrenic abscess is suspected.

November 21. Temperature normal. Patient has no pain and feels perfectly well. X-ray examination of chest shows extensive shadow in the lower part of the right lung, the right diaphragm is pulled up. X-ray diagnosis: pathological process above the right diaphragm, a serofibrinous pleurisy. No signs of a subphrenic process.

November 23. Patient out of bed yesterday. Temperature rose in the evening to 38° C; pulse, 84. Patient complains of a sharp pain in the right lower chest. The right-sided dullness has increased and extends up to the level of the eighth dorsal vertebra.

November 24. Gastro-intestinal X-ray examination shows normal stomach and duodenal cap. No sign of a previous ulcer perforation. X-ray diagnosis, from chest fluoroscopy: Serous pleurisy.

November 26. Evening temperature 39.2° C; pulse, 100. Patient perspires freely. No dyspnœa. Right thorax moves less than the left. Dullness over the right base posteriorly extends to the level of the seventh dorsal vertebra. Breath sounds absent, spoken voice diminished. The liver dullness is not increased downward. Over the right thorax a very slight œdema of the skin is present. This is thought to be the result of the iodine applications.

November 27. Slight tenderness upon pressure localized over the right eleventh and twelfth ribs. Clinical diagnosis: subphrenic abscess.

November 28, X-ray examination of the chest. No signs of a subphrenic abscess. To visualize the diaphragm better the roentgenologist attempted to inject air into the suprahepatic space. Needle inserted in the eighth intercostal space in the anterior axillary line under the fluoroscope and 80 cubic centimeters of air injected. After this procedure nothing new could be made out. After the injection patient suddenly went into a state of collapse. Dyspnœa was marked. Perspiration was profuse. The face was pale and cyanotic. The pulse was 100 and thready. After caffeine intramuscularly and digalen intravenously patient recovered in about 15 minutes.

November 29. Operation was decided upon. After preparation of patient, it was decided to try exploratory aspiration. The needle was inserted beneath the twelfth rib in the posterior axillary line and directed upward and backward without entering the pleural or peritoneal cavities. A thick, yellow, slightly foul-smelling pus was obtained.

Operation. Patient lying on the left side with kidney pillow. Ether anæsthesia. Incision was made over and down to the twelfth rib, extending posteriorly to within 4 centimeters of the midline. Subperiosteal resection of the entire twelfth rib. Transverse incision of the musculature was made at the level of the first lumbar spinous process, down to the renal fascia through which the perirenal fat was seen. The upper margin of the incision was elevated by means of broad, blunt retractors. By means of the index finger the renal fascia and the peritoneum, which was continuous with the renal fascia, were bluntly separated from the diaphragm. The peritoneum was œdematous, thickened, and appeared cloudy. Wound tamponaded. Exploratory aspiration of the

pleural cavity *above* the diaphragm yielded a clear, yellow, serous exudate, thus ruling out the presence of a co-existing empyema. Removal of tamponade.

An exploratory aspiration of the subhepatic space was done between the right border of the liver, which could easily be seen and palpated, and the upper pole of the right kidney yielded nothing. Tamponade of the wound in this region. Exploratory aspiration of the suprahepatic space by means of the Clairmont curved needle was fruitless on the uppermost portion of the liver. Aspiration posteriorly in the direction of the right upper posterior space yielded the identical pus as obtained by the preoperative puncture. Peritoneum was further separated from the under surface of the diaphragm in the direction of the abscess. Peritoneum over the abscess was broken through with the finger and about 300 cubic centimeters of pus evacuated. Large rubber drainage tube and iodoform gauze introduced into abscess cavity.

November 30. Temperature has fallen to normal. Wound drains considerably. Patient feels much better. Iodoform gauze removed.

December 5. Rubber tube loosened and slightly withdrawn. Drainage has markedly decreased. Patient feels perfectly well. Dullness over the right base has diminished.

December 9. Drainage has ceased. Drain removed. Patient feels fine.

December 15. Patient is out of bed.

December 20. Wound is almost completely healed, shows no reaction. Dullness over the right base has practically disappeared. No evidence of a pleurisy present.

December 23. Wound entirely healed. Patient has no symptoms. Appendectomy refused.

Case 2. Amalie B., age 18, seamstress, complained chiefly of pain in chest, which was aggravated by breathing, and abdominal pain. The mother and father are living and well. She has no brothers or sisters. No chronic illnesses are revealed in family history. Patient had measles at 4 years; scarlet fever at 5 years; no operations or accidents. In October, 1922, patient had attack of abdominal pain associated with vomiting. After 4 days' diet the attack subsided. Menses began at 14, are painful, always regular and flow moderate.

Present illness. On January 15, 1923, less than an hour after the evening meal, patient suddenly experienced a cramp-like pain in the lower abdomen. Shortly afterward patient became nauseated and vomited. After a bowel movement patient experienced a heavy sensation in lower abdomen, "as if there were not enough room for all the organs." During night patient vomited three times. On January 16 a doctor was called who diagnosed a light attack of appendicitis and ordered hot applications to the abdomen. The pain became localized in the right lower quadrant and more severe. Temperature normal. January 18 patient complained of burning upon urination and also of a dull pain in the right flank which became so severe that it was impossible for patient to lie upon the right side. January 20 patient suddenly experienced in the right chest and high in the flank lancinating pain which was aggravated by breathing. On January 21 for the first time the temperature was above normal, 38.4° C. On January 23 patient was sent into surgical clinic; diagnosis, appendicitis.

Physical examination. Patient is a well-developed, well-nourished, anæmic-looking young girl of typical asthenic habitus. Face is very pale and slightly cyanotic. Temperature, 38.6°; pulse, 120; respiration, 30. Scleræ are clear, pupils equal, regular, and react to light and accommodation. Examination of ears and nose is negative. The teeth are in good condition. Examination of pharynx and tonsils is negative. The tongue is moist, but is covered with a heavy white coat. Examination of neck shows no abnormality. The thorax is well-developed. Thoracic movement on the right side is considerably less than on the left. In left lung the percussion note is resonant. Base of the lung moves well by deep breathing and extends to the level of the eleventh rib posteriorly. Breath sounds vesicular. No râles. In the right lung there is dullness extending from the base upward to the level of the eighth rib posteriorly. Breath sounds absent, spoken voice diminished over this area. The upper level of the dullness is straight posteriorly and laterally. Lung boundary above the dullness is stationary. Breath sounds over the remaining portion of the lung vesicular. No râles. Cardiac dullness extends from the left mamillary line to the right border of the sternum. Impulse in the fifth intercostal space. Heart sounds clear, no murmurs. The abdomen is slightly distended, the right side seemingly more so than the left. On the left side is a slight resistance upon pressure. On the right side, beginning about 5 centimeters from the mid line, is a marked resistance, which is also tender. In this region there is also dullness which extends laterally to within 1 centimeter of the anterosuperior iliac spine, above to the fourth rib, and below to Poupart's ligament. Over this entire area there is an indefinite resistance which is not sharply demarcated from the surrounding tissues. In the right lower abdominal quadrant, and even so in the right flank and especially localized just to the right of the twelfth rib, is a marked tenderness. No œdema is demonstrable. Rectal examination shows an atonic sphincter. There is a diffuse tenderness upon pressure on both the right and left sides. Urine is negative for albumin and sugar; for sediment, negative. Diagnosis: (1) retrocæcal appendicitis, (2) subphrenic abscess, (3) empyema (?)

Immediately upon admission of the patient in the hospital as an emergency, on account of the dyspnœa, cyanosis and pain in the chest, the ward interne's attention was directed to the chest before a complete history was taken. Thinking the case an empyema he immediately explored the chest with the aspirating needle. A thin, bloody, foul-smelling pus was obtained. Microscopic examination showed polymorphonuclear leucocytes and gram-negative

bacilli. It was easy to see from the history that if an empyema existed it was also associated with a subphrenic abscess, so operation was decided upon.

Operation. Patient lying upon the left side with kidney pillow. Ether anæsthesia. Oblique incision, 15 centimeters long, over the twelfth rib, beginning at the outer border of the erector-spini musc. and extending downward and forward in the direction of the anterior superior iliac spine. A subperiosteal resection of the entire twelfth rib was done. Transverse incision was made through the musculature at the level of the first lumbar spinous process down to the renal fascia. Through the long skin incision the muscles lower down were separated in their respective directions and the retroperitoneal and retrocæcal spaces explored bluntly in order to see if there was a possible abscess formation in these regions. Nothing was found. The upper margin of the incision was elevated by means of broad, blunt retractors and the renal fascia and the peritoneum, which was continuous with it, was separated from the under surface of the diaphragm. The peritoneum was thickened and œdematous. Through the peritoneum the right margin of the liver was seen and palpated. Exploratory aspiration of the pleural cavity *above* the diaphragm, with a finger in the suprahepatic space below the diaphragm, to prevent the needle from passing through it, yielded nothing, making it possible to rule out an existing empyema. By exploratory aspiration of the subhepatic space between the right border of the liver and the upper pole of the kidney, a thick, yellow, foul-smelling pus was obtained, thus establishing a diagnosis of a subhepatic abscess. The needle was withdrawn without opening the abscess and this region of the wound tamponed with gauze. Exploratory aspiration of the suprahepatic space by means of the Clairmont curved needle yielded pus which was identical with that obtained by the pre-operative puncture, thus confirming the diagnosis of a suprahepatic abscess. The peritoneum was separated from the under surface of the diaphragm in the direction of the abscess. The abscess was opened by breaking through the peritoneum over it by means of the finger and about 250 cubic centimeters of pus obtained. The abscess cavity was quite large but was well walled off. The subhepatic abscess was opened by breaking through peritoneum with finger and about 200 cubic centimeters of pus evacuated. A large rubber drainage tube and iodoform gauze drain were introduced into each abscess.

January 24. Wound drains considerably. Iodoform gauze removed. Temperature has fallen to normal. Patient feels better.

January 30. Temperature normal. Wound drainage less. Rubber tubes loosened and withdrawn slightly. Patient feels fine.

February 1. Wound has ceased draining. Drains removed. Patient out of bed.

February 10. Wound practically healed.

February 14. Wound entirely healed. Appendectomy revealed chronically diseased appendix.

These two cases represent two phases of the difficulties that one encounters when dealing with a subphrenic abscess, and we have chosen them out of the 17 cases operated on in the clinic according to this method because they are so instructive.

Case 1 emphasizes the importance of careful and repeated clinical observation necessary for the *early* diagnosis of subphrenic abscesses and shows that accurate clinical observation is far more important than the X-ray, which in this case gave repeatedly negative results. Exploratory puncture, although not necessary for the diagnosis, in this case was carried out after the patient was prepared for operation and the abscess found to be located in the typical right upper posterior space.

Case 2, as a more advanced one, presents little difficulty in the making of a diagnosis. However, it is instructive and shows very well one of the advantages of our method over either the transpleural or the transperitoneal methods, in that it was possible to locate and drain both the suprahepatic and infrahepatic abscesses by means of one and the same operative procedure. Had either of the methods mentioned been used in this case, one of the abscesses would have been overlooked.

This is very important practically because in more than 50 per cent (Maydl and Piquands, 53 per cent, Barnard, 60 per cent) of subphrenic abscess cases complicating appendicitis, there are two co-existing abscesses, one above and one below the liver.

TECHNIQUE OF RETROPERITONEAL METHOD

1. Incision over and down to the twelfth rib to within 4 centimeters of the midline posteriorly. Subperiosteal resection of the entire twelfth rib. (Fig. 4.)

2. *Transverse* incision of the musculature below the bed of the resected twelfth rib at the level of the first lumbar spinous process, which should be marked before the operation. In this way the pleura will with certainty be avoided. Careful dissection down to the renal fascia, which is recognized as a smooth, shining, fibrous layer. Through it the renal fat can be seen. (Figure 5 shows the bed of the resected twelfth rib and the transverse incision down to the renal fascia.)

Fig. 4. Exposure of the twelfth rib.

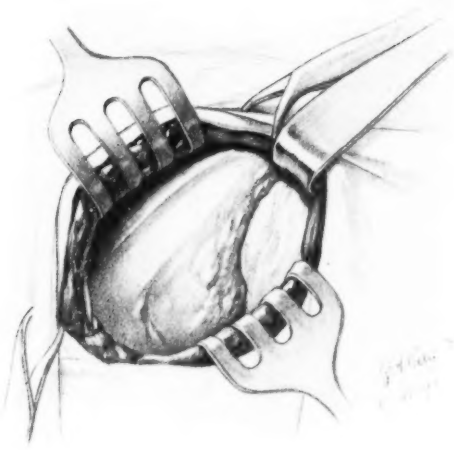

Fig. 5. In the upper part of the wound can be seen the bed of the resected twelfth rib. Below, running in a perpendicular direction, is the incision through the muscle. The lower muscular flap is retracted and the renal fascia can be seen in the right lower corner.

3. If a retrocæcal or retroperitoneal abscess is suspected, the skin incision can be extended downward and forward in the direction of the anterosuperior iliac spine, the muscles separated in their respective directions and the retroperitoneal and retrocæcal regions explored.

4. Blunt separation of the musculature from the renal fascia for a short distance above and below the wound. Broad, dull retractors are placed above which elevate the diaphragm and pleura and protect them from injury. Blunt separation by means of the index finger of the peritoneum above from the under surface of the diaphragm. The peritoneum is found continuous with the renal fascia. This separation is easily accomplished up as far as the dome of the liver, thus enabling one to reach those abscesses located high on the liver surface. If an abscess is present, the peritoneum is markedly œdematous and the separation is even more easily carried out. Anatomical studies have shown that if the separating finger follows the direction of the diaphragmatic fibers which run parallel to the ribs, the separation is still easier.

5. Aspiration of the pleural cavity *above* the diaphragm in those cases in which an empyema is suspected. This is carried out with a finger in the subphrenic space between the separated peritoneum and the diaphragm, so that one can feel the aspirating needle and prevent its passing through the diaphragm.

6. Exploration of the subhepatic space by means of the aspirating needle, the point of election lying between the visible right lower border of the liver and the upper pole of the right kidney (Fig. 6). If pus is obtained, the needle is withdrawn without opening the abscess and the area tamponaded with gauze until after exploration of suprahepatic space.

7. Exploration of the suprahepatic space by means of the curved needle which was advocated by Clairmont for exploration of the upper surface of the liver (Fig. 6). It must be borne in mind that the favorite site of election for a postappendiceal abscess in the subphrenic region is the *right upper posterior space*. For this reason it is of practical importance to direct the needle well posteriorly. If pus is obtained, the obscess is opened by breaking through the peritoneum over it by means of the finger (Figs 7, 8, and 9). If pus has been obtained by the exploration of the subhepatic space, this abscess is likewise drained. Introduction of *large* rubber drain-

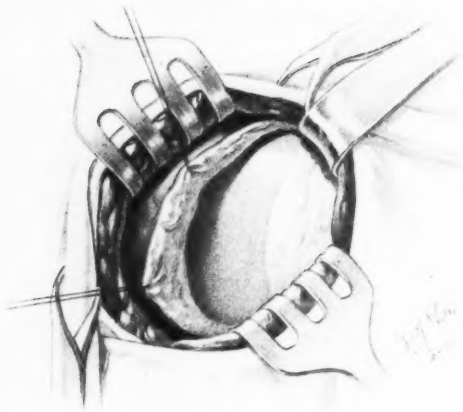

Fig. 6. The lower edge of the diaphragm is elevated by means of two sutures. The peritoneum has been separated from the under surface of the diaphragm. The curved perpendicular line on the right is the right liver border, to the right of which lies the renal fascia through which the renal fat can be seen. Beneath the visible liver border is the point of election for the exploration of the subhepatic space. On the left, between the diaphragm and its separated peritoneum, is the point of election for the exploration of the suprahepatic space.

age tubes and iodoform gauze drains into the cavities. We disapprove of irrigation of the abscess cavities because of the danger of breaking through the pyogenic membrane.

8. If an empyema exists (determined by exploratory puncture of the chest, paragraph 5) the pleural cavity may be drained by simple incision of the pleura *above* the diaphragm without the further resection of ribs. Introduction of large rubber drainage tubes.

ADVANTAGES OF RETROPERITONEAL METHOD

1. It is possible to explore and drain both a suprahepatic and an infrahepatic abscess by means of one and the same procedure.

2. There is no danger of contaminating an unaffected pleura or peritoneum. By the transpleural approach, even though one uses the various operative procedures to shut off and protect the free pleural cavity, such as suturing the diaphragm to the pleura, etc., there is always the danger of a resulting empyema. Grueneisen (5) found that in 28 per cent of subphrenic abscesses opened through a normal pleura and in 35 per cent of cases in which there existed sterile fibrinous adhesions, empyema developed in spite of the various operative procedures employed to protect the pleura. Perutz (10) in 67 per cent and Piquands (11) in 78 per cent of cases of subphrenic abscesses found the pleura unaffected. To avoid the pleura when draining a subphrenic abscess is of utmost importance because in 75 per cent of cases (Nather) the pleura is sterile. For practical purposes we can consider the pleural cavity sterile in all cases of abscesses in the subphrenic region, even in those cases in which there is present a pleural exudate or fibrinous adhesions.

Experience shows that an exudate and fibrinous adhesions in the pleural cavity are irritation products of a subphrenic abscess. For this reason the pleural change is of great diagnostic importance. These co-existing pleural complications disappear without any further treatment after the early drainage of the subphrenic abscess, which is the source of the irritation. Empyema develops only in those cases in which drainage is instituted late.

3. By means of our operation it is necessary to resect only the short functionless twelfth rib, producing a wound surrounded entirely by soft parts. As soon as the drainage has ceased and the drains are removed, the walls of the drainage canal fall together and obliterate the cavity.

On the other hand the partial resection of the ribs necessitated by the transpleural method produces an opening, the walls of which are rigid and in reality splinted so that the parietes cannot collapse.

The time taken for the wound to heal and likewise the patient's convalescence is, as is self-evident, much shorter after the retroperitoneal operation even if an empyema coexists.

4. An important surgical advantage is that the abscess is drained in its most dependent portion.

5. By simple extension of the incision downward and forward, it is possible to explore the retroperitoneal, retrocæcal and perinephritic spaces. In combination with the preperitoneal operation (Clairmont-Na-

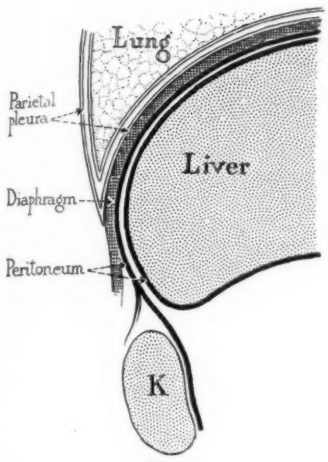

Fig. 7.

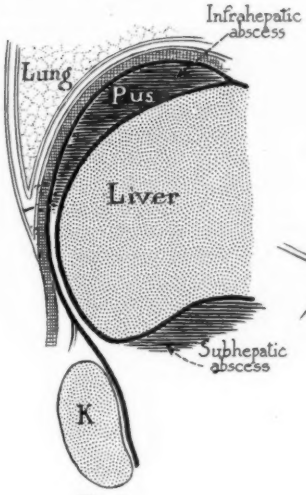

Fig. 8.

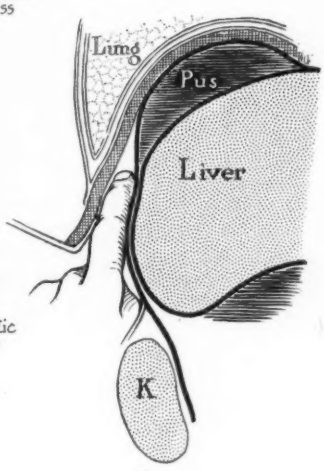

Fig. 9.

Fig. 7. Schematic anteroposterior section showing the normal relations of the right subphrenic region. The shaded portion above is liver and that below is the right kidney. The heavy black line represents the peritoneum.

Fig. 8 Schematic representation of a suprahepatic and intrahepatic abscess (Case 2). The normal potential suprahepatic space is filled with pus. The diaphragm and lower lung border are pushed upward and the pleural angle is partially obliterated. Beneath the liver is the subhepatic abscess.

Fig. 9. Schematic drawing showing the separation of the peritoneum from the under surface of the diaphragm as far as the abscess.

ther, 9) the entire subphrenic region can be drained.

6. There is less shock associated with the retroperitoneal operation than with the transpleural, as only one body cavity is opened.

CONCLUSIONS

1. Careful, exact clinical observation of cases following appendicitis which run an abnormal course leads to an early diagnosis in the larger percentage of cases of complicating subphrenic abscess.

2. In those cases in which clinical observation does not lead to a diagnosis, and it is necessary to resort to exploratory aspiration, it should *not* be carried out transpleurally but retroperitoneally beneath the diaphragm.

3. In cases of subphrenic abscess it is unnecessary and dangerous to use a method of drainage which exposes uninvolved pleura (60 to 70 per cent) or peritoneum to infection.

4. Especially in those cases of secondary abscesses in the subphrenic region complicating appendicitis, it is necessary to use an operation by which an abscess in subhepatic and suprahepatic spaces can be drained at the same time. This combination occurs in more than 50 per cent of subphrenic abscesses complicating appendicitis. The retroperitoneal operation fulfills these requirements.

5. A co-existing empyema can also be drained through the same incision without further resection of ribs.

6. The retroperitoneal operation is surgically and anatomically the operation of choice in the drainage of those subphrenic abscesses complicating appendicitis.

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DEPARTMENT OF TECHNIQUE

THE OPEN OPERATION FOR CONGENITAL DISLOCATION OF THE HIP

By HERBERT P. H. GALLOWAY, M.D., C.M., F.A.C.S., Winnipeg, Manitoba

IT is only within recent years that congenital dislocation of the hip has been rescued from the realm of incurable surgical conditions. The demonstrations given by Lorenz, of Vienna, during his visit to America in 1902 caused a general awakening of interest in this affection, and since that time the manipulative method, either as originally performed by Lorenz or variously modified, has been the accepted treatment. The results of these manipulative procedures have been anything but uniformly satisfactory, the percentage of real cures claimed by most operators being small. Moreover, not a few actual disasters, such as fracture of the femur, separation of the capital epiphysis of the femur, fracture of the pelvis, injury to peripheral nerves and gangrene of the extremity, have resulted from unwise attempts to effect reduction in patients who were too old, or whose tissues were so unyielding that extreme and unjustifiable force was used. However, inasmuch as some patients were actually cured and many others functionally improved by the Lorenz method and its various modifications, most surgeons have preferred to treat their patients by manipulation, for few have had any extended experience with the open operation.

As far as I am aware, the first surgeon on this continent who strongly opposed the manipulative method and advocated open reduction was the late Harry M. Sherman, of San Francisco, who in 1904 presented a remarkable paper at the meeting of the American Orthopedic Association in Atlantic City. Dr. Sherman's paper must be read to be appreciated. Discouraged with the generally unsatisfactory results of the manipulative method he abandoned it in 1898, and with one exception employed the cutting operation in all of his subsequent cases up to the time his paper was presented 6 years later.

The following quotation from Sherman's paper affords food for thought:

"As regards the manipulative method, I am sure that Lorenz told the whole truth when he stated that the obstacle to reduction was the narrowed part of the capsule at the posterior and superior, or superior part of the acetabular rim. If the opening at this narrowed part is big enough to permit the head to pass, reduction can be accomplished by manipulation, and may be maintained if the acetabulum is deep enough. I have in two instances done this, I know. But in the twenty-eight hips in which I have done arthrotomy, and in which I have explored the narrow part of the capsule by my finger, and so know its size and the strength of its walls, there has been but one case in which the passage of the head would have been possible. I am not too dogmatic when I say that no possible force could have put the femoral head through the narrow part of the capsule in any of the other cases."

Up to the time that Sherman's paper appeared, my own experience with manipulative methods had been about the average; only a very few actual cures and a fair percentage of cases functionally improved. The most disturbing degree of uncertainty attended the treatment of every case; one always had the feeling that the final outcome was a gamble. Dr. Sherman's paper was so convincing that I immediately began to try the open operation in selected cases, and finally abandoned the manipulative method. In June, 1920, I read a paper at the annual meeting of the American Orthopedic Association strongly advocating the open operation and presenting an impartial review of my results. Since that time the operation has been further developed and improved, until now the results *in young children* are so uniformly satisfactory that one no longer approaches these cases with a feeling of dread or uncertainty, but with confidence that the treatment is simple, safe and practically certain to result satisfactorily.

It must not be forgotten that each worker in the field of open operations for this condition is more or less of a pioneer, for, because of the almost universal employment of manipulative methods the open operation has been practically without either teachers or students. The writer never had the advantage of seeing Dr. Sherman operate, but for a long time followed, as closely as possible, his published description. Gradually, however, certain modifications were made, and, since my

Fig. 1. The Sprengel incision.

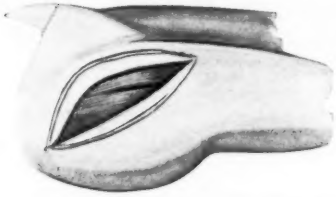

Fig. 2. Interval between tensor fasciæ femoris and rectus.

Fig. 3. Muscles divided along crest of ilium and retracted. Rounded outline of head visible through capsule.

former paper appeared, some details have been introduced which have proved highly advantageous.

Let it be clearly understood, however, that my claim that the open operation is simple, safe, and reliable, applies particularly to children under 3 years of age who have never been subjected to treatment by manipulation or otherwise.

DESCRIPTION OF THE OPERATION

In my former paper I described two paths of approach to the hip joint, the anterior and the posterior. I now employ, exclusively, the exposure first described by Sprengel, and more recently popularized by Smith-Peterson, who appears to have been unaware of Sprengel's prior description.

Patient is placed on the table with a sandbag under the trunk, so arranged as to raise the pelvis on the side to be operated on. Beginning at a point just below the crest of the ilium and from 2 to 3 inches behind the anterior superior spinous process, an incision is carried forward just below the crest to a point immediately below the tip of the anterior superior spinous process. The incision is then carried down about 3 inches in the long axis of the thigh. The first incision should include merely the skin and superficial fascia. Skin towels, backed with waterproof material, are then clamped on the edges of the wound. With a fresh knife the interval between the rectus and tensor fasciæ femoris is now located and opened up; then the incision along the crest of the ilium is deepened to the bone. In young children, it is necessary to do this with some care, because the bone is so thin and soft that it can easily be cut through. With a periosteal elevator, the muscles are easily stripped from the ilium and the capsule of the hip joint fully exposed. By rotating the limb inward and outward, the head is now readily felt, usually a little below the level of the anterior superior spinous process.

While the limb is held fully rotated inward a longitudinal incision is made through the capsule, this incision being an inch, or slightly more, in length. The capsule is always surprisingly thick, and this incision should be carried down through it with great care so as not to wound the cartilage of the head. The object of rotating the limb inward, before commencing the incision into the capsule, is that this effectually guards against any possible wounding of the ligamentum teres. The moment the joint has been opened, some synovial fluid escapes and the glistening head can be seen.

The longitudinal incision through the capsule is now converted into a crucial incision by incising the anterior and posterior margins of the longitudinal cut to the extent of from one-quarter to three-quarters of an inch.

If the limb be now rotated outward the ligamentum teres, which is nearly always surprisingly large, comes into view, and, by following it in toward the pelvis with the finger, the acetabulum is located.

In practically every instance, deep in toward the joint, a constriction is felt in the capsule; to the finger it gives the sensation of a sharp crescentric fold, the free concave margin of which looks upward toward the roof of the acetabulum. This is divided freely in a downward direction, using for this purpose a hernia knife which is introduced flat-wise along the left index finger, cutting edge turned toward the constriction after it has been introduced to sufficient depth.

In some instances the head may, without any difficulty, be manœuvred into place by abducting the limb and rotating it inward, but usually it will be found of advantage to use a hip skid. The instrument I use is one which has been slightly modified from a model kindly furnished me by Dr. W. R. MacAusland. This instrument is introduced into the acetabulum and holds the soft tissues out of the way while acting as a kind of "shoe horn" along which the head is slid deeply into the acetabulum.

I always redislocate the head once or twice so as to test the position of greatest stability. It will

usually be found that abduction of from 45 to 60 degrees and pronounced inward rotation will maintain a perfectly stable reduction.

With a continuous suture of plain catgut, the deep tissues are quickly brought together, particular care being used to bring the muscles which were divided along the crest of the ilium into place again. Usually no attempt is made to close the opening in the capsule; in fact, the moment the head is reduced the incision in the capsule falls together so perfectly that often it cannot be seen. The skin incision is closed with three or four silkworm-gut sutures and a continuous catgut suture.

It is of course important that while the tissues are being stitched up and the plaster applied the position of stable reduction shall be maintained by a reliable assistant. In many cases, however, the reduction is so stable that the limb simply lies in the proper position during the closure of the wound without any special attention being paid to it. A plaster-of-Paris spica is applied from the nipples to just above the ankle, the knee being slightly bent so as to maintain the position of internal rotation.

An X-ray picture is taken through the plaster 2 or 3 days later. About 3 weeks after the operation, the plaster is removed and the stitches taken out. The plaster is then reapplied without changing the position of the limb, except that the knee is bent to a less degree. From that time on the child is encouraged to bear weight on the limb. In from 6 to 8 weeks the plaster is again removed and reapplied, this time the degree of abduction and inward rotation being slightly lessened.

One or two other changes of the plaster are made, at intervals of about 6 weeks, and each time the limb is brought nearer to the normal position. Within 5 or 6 months all dressings are discarded and the child allowed to go about freely.

Quite recently interest in the treatment of congenital dislocation by manipulation has been renewed by the remarkable claims put forward by Denuce. His method differs materially in important particulars from that of Lorenz, and it is claimed that 98 per cent of his cases are cured. On this continent Dr. Z. B. Adams, of Boston, is Denuce's leading disciple, and having had the privilege of witnessing his demonstration of the Denuce method I can testify that it is very convincing.

What of the open operation, if future experience demonstrates that the results claimed by Denuce can be regularly secured by other surgeons? Other things being equal it is granted that if a congenital dislocation can be reduced in a few minutes by a simple and easy manipulative procedure which requires no elaborate surgical technique, it is preferable to an open operation which demands perfect asepsis, and which should never be undertaken except by a highly trained surgeon.

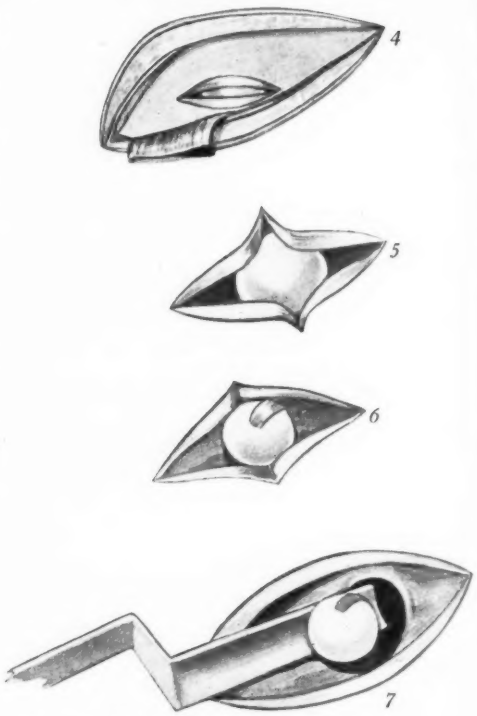

Fig. 4. Incision through capsule exposing head.
Fig. 5. Longitudinal incision through capsule converted into crucial incision.
Fig. 6. Ligamentum teres brought into view by rotating limb outward.
Fig. 7. Hip skid introduced into acetabulum acting as a "shoe horn."

But are other things equal? Denuce does not allow his patient to begin walking until about 1 year after the hip has been reduced, and he appears to regard as essential a course of rather elaborate after-treatment extending over many months, and even as long as $2\frac{1}{2}$ years. After the open operation in children under 3 years, walking in the plaster is encouraged within a few weeks, and the plaster is abandoned and no further treatment considered necessary after 5 or 6 months. I believe that treatment could be dispensed with much earlier in most cases, but have not felt justified in taking chances to discover

what is the minumum safe period of after-treatment. The advantage of a method which can be concluded in 6 months, or less, over one requiring several times as long, is too obvious to require comment; especially is this so when one is dealing with private patients who have come a long distance, who cannot remain away from home indefinitely, and with whom expense may be an important consideration.

The fact that Denuce's method requires such prolonged after-treatment is not only an objection to it, but in my opinion it affords additional evidence in support of my belief that cure by any manipulative method can be brought about only by the gradual absorption through pressure of capsular tissue, which more or less completely blocks the entrance to the acetabulum and effectually prevents the cartilage of the head from coming into contact with the cartilage of the acetabulum at the time the manipulative reduction is effected. In other words, it is my belief that reduction by manipulation is practically always incomplete at first, and becomes stable only after the capsular tissue pushed before the head has become absorbed.

In this connection the reader is once more referred to Dr. Sherman's statement that in twenty-eight hips in which he had explored the narrow part of the capsule and so knew its size and the strength of its walls, there was but one case in which the passage of the head would have been possible, and that no possible force could have put the femoral head through the narrow part of the capsule in any of the other twenty-seven cases.

My own experience fully confirms Dr. Sherman's claims. In doing the open operation I have frequently invited my assistants to feel the constricted opening into the acetabulum before and after dividing it with the knife. As soon as the constriction has been divided it is plain that the real obstacle to reduction has been removed and the head can then be buried deeply and securely in the cavity which nature provided for it. It is an interesting fact, which I have often observed, that when this obstacle has been removed the acetabulum will often be found to be much more capacious than the X-ray picture would lead one to expect.

It is granted, as a serious objection to the open operation, that it should never be undertaken except by surgeons who have complete confidence in their operative skill, and who can operate under conditions such that failure of any link in the chain of asepsis is practically impossible. The same objection, however, applies to many other surgical procedures and should not deter a surgeon who has learned to have confidence in himself and in his surgical environment.

The ideal time for operating is between 2 and 3 years. In a general way the operation becomes more difficult and uncertain as the age advances, although exceptionally, in children from 5 to 12 years of age, no special difficulty is encountered. In children of 3 years, or younger, who have not been subjected to manipulative or other treatment, the ligamentum teres is usually intact and is an important guide in locating the acetabulum. In older children, and in those who have had a previous unsuccessful manipulative reduction, the ligamentum teres is usually absent, or is found detached from the head and curled up in the acetabulum.

The treatment of congenital dislocation in adults is an entirely different problem from that encountered in young children, and its discussion does not come within the scope of this paper.

The illustrations showing various steps in the open operation are diagramatic rather than anatomically exact.

RECONSTRUCTION OF THE URETHRA AFTER COMPLETE LOSS, COMPLICATING AN EXTENSIVE VESICOVAGINAL FISTULA

The Operative Technique Employed with Success[1]

By GEORGE GRAY WARD, M.D., F.A.C.S., New York
From the Clinic of the Woman's Hospital

WHILE the difficulties to be overcome in the curing of extensive vesicovaginal fistulæ are often appalling, yet it is surprising what patient persistence on the part of both patient and surgeon will accomplish in closing large defects in the bladder base. However, where there is added to these difficulties the complication of a destruction of the urethra and consequent loss of control, we have, indeed, a problem which will try our skill and ingenuity to the utmost. No two cases are exactly alike and the technique must frequently be improvised to meet the particular conditions present. Therefore, carefully executed illustrations, made during the operation, of the steps employed where success has been attained, must be of help to others in solving like problems. This, then, is my reason for reporting this case.

Mrs. M. I., age 23, married 2 years, first came under my care at the Woman's Hospital in October, 1920, complaining of complete urinary incontinence dating from her labor in December, 1919, when she had a full term baby delivered by craniotomy. During delivery the cervix was badly torn and a traumatic vesicovaginal fistula was produced. The patient entered the Lying-In Hospital in January, 1920, for the repair of the fistula, and I am indebted to Dr. Kosmak for the details of the history while in that institution as follows: "Exploration under anæsthesia showed the fistula about one-half inch in diameter including the posterior portion of the urethra and involving the trigone. The vault of the vagina showed no opening communicating with the uterus and no trace of the cervix.

"The vaginal vault was very rigid, and full of scar tissue, and the bladder firmly anchored. It was impossible to separate the bladder wall from the uterus because of the inability to locate any cervical opening. Wide lateral incisions in the lower portion of the vagina failed to give sufficient room to expose the operative field thoroughly. An exploratory laparotomy was, therefore, done and disclosed a small, well-involuted uterus with normal tubes and ovaries. The lower segment of the uterus and the bladder were firmly embedded in a mass of scar tissue, so that the uterus could not be pulled upward. An incision was made transversely in the fundus and a sound carefully intro-

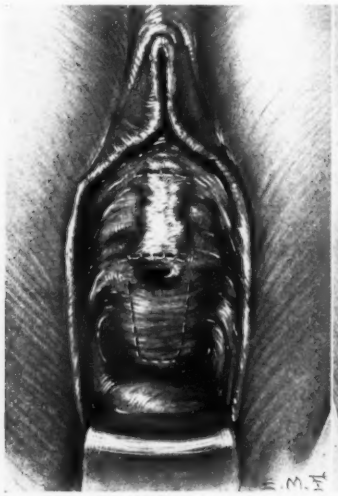

Fig. 1.

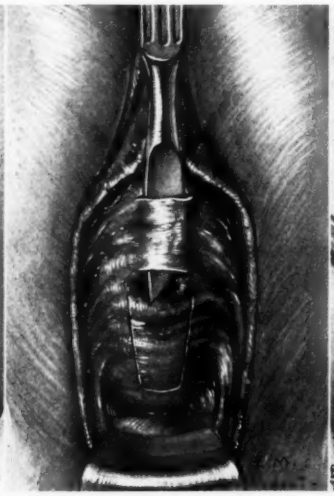

Fig. 2.

Fig. 3.

Fig. 1. Reconstruction of the urethra. The condition of the parts shown after the operations for closure of extensive vesicovaginal fistula which involved loss of the anterior vaginal wall and trigone of the bladder the size of a twenty-five cent piece. The opening shown is at the site of the internal meatus. The white area above it represents the superior wall of the urethra, the posterior and lateral walls having been destroyed. Outline of the flap and incision.

Fig. 2. Tunnel made with a scalpel in the vestibule behind the site of the urethra.

Fig. 3. Dissecting up the flap for the new urethra which is left attached to the opening in the bladder.

[1]Read before the American Gynecological Society, Hot Springs, Virginia, May 21–23, 1923.

Fig. 4.

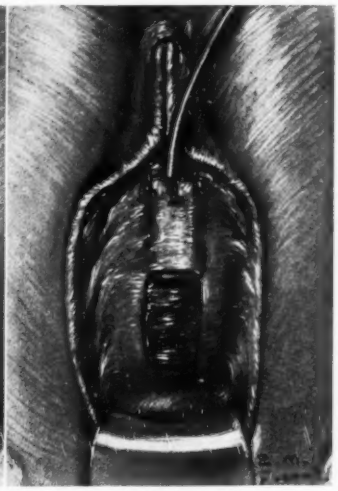

Fig. 5.

Fig. 4. Drawing the flap through the tunnel to form the new urethra.
Fig. 5. The flap sutured to the upper opening of the tunnel and a small catheter inserted into the bladder to maintain the patency of the new urethra.

Fig. 6. The denuded area on the anterior vaginal wall is extremely thin as the flap was procured from the scar tissue of the previous operation for closure of the defect; therefore it requires reinforcement. The right labium minus is put on the stretch and an incision made throughout its length on its inner surface opening its folds.

duced in an attempt to find the outlet. This was accomplished with moderate pressure and a soft rubber catheter pushed through this artificial opening in the vaginal vault, and left *in situ*. The fundus uteri was closed with interrupted gut sutures, and no further attempt to close the

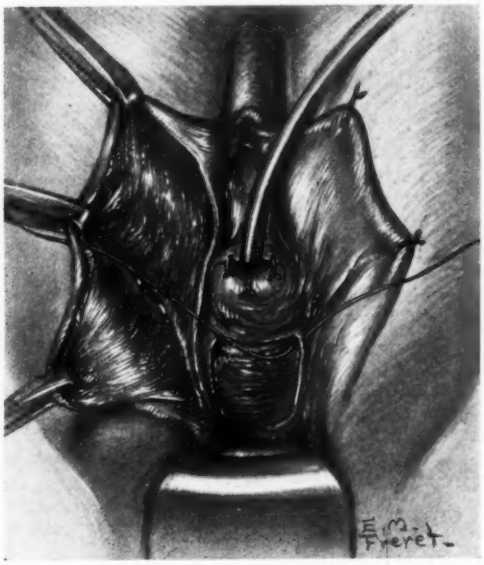

Fig. 7. The dissection unfolding the labium minus complete, and the first suture passed.

Fig. 8. Completing the suturing of this attached flap to the defect at the bladder base.

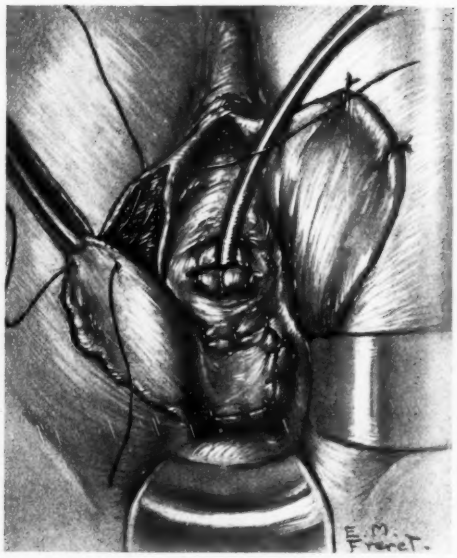

Fig. 9. The denuded area of the vagina and the bladder completely closed with the attached flap and sutures passed to close the upper angle of the incision.

fistula was made. On May, 1920, on re-examination, the uterus was found anteverted, not freely movable, apparently slightly enlarged. The patient had had a menstrual flow lasting 24 hours 2 weeks previously. The fistula seemed reduced in size."

Evidently the stenosis of the uterine canal had been relieved by this operation as the patient gave us a history of regular menstruation without discomfort since that time. Unfortunately, our difficulties were increased on account of the patient being very short and very obese, weighing over 200 pounds, but this was partially compensated for by her extraordinary happy disposition and common sense, and throughout she gave us every co-operation which, in no small measure, contributed to the success of our efforts.

Our examination showed a vesicovaginal fistula at the site of the trigone and involving the urethra, nearly as large as a 25 cent piece. There was dense scar tissue in the vaginal vault and on both sides of the pubic arch, making the base of the bladder and the anterior vagina and cervix firmly fixed. The posterior vagina also was full of scar tissue, the result of the previous operation.

On October 26, 1920, I operated as follows: A typical Schuchardt incision was made extending from the vault of the vagina to the coccyx. This gave an access without which it would scarcely have been possible to reach the parts involved (1). Incisions were then made through the scar tissue of the vaginal vault to the subpubic arch, and above, and on either side of the site of the urethra, thus loosening the tissues in order to allow approximation of the margins of

Fig. 10. The completed operation.

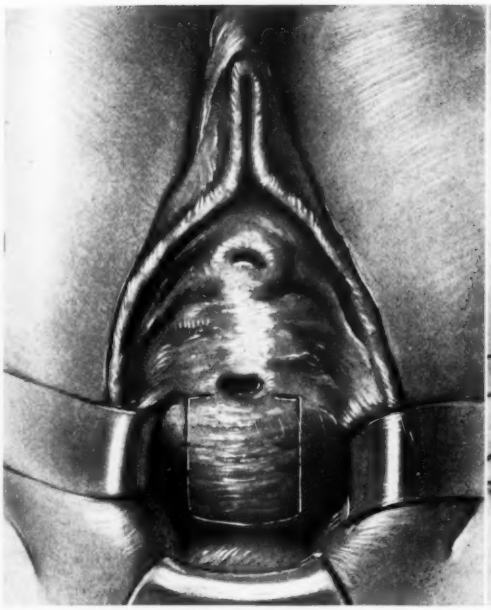

Fig. 11 (at left). Outline of flap to be at the same location as in the previous operation but wider.[1]

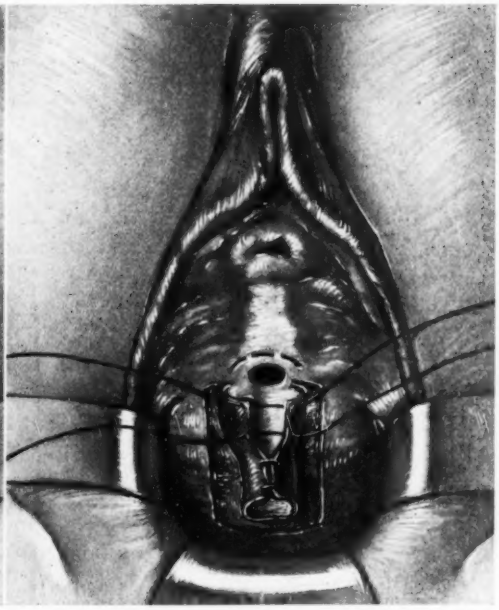

Fig. 12. Lateral edges of the flap united by sutures.

the fistula without tension. The vaginal edges of the fistula were dissected free from the bladder edges for approximately one-quarter to one-half an inch and the bladder opening united with interrupted No. 1 tanned gut sutures. Silkworm-gut sutures closed the vaginal edges, and the incisions in the scar tissue were closed in the reverse direction with catgut. On the left side of the vaginal vault, it was impossible to close the incision in the scar tissue because of the tension, and it was left to granulate. A self-retaining catheter was inserted, and the Schuchardt incision was closed. No attempt was made to construct a urethra.

On November 23, 1920, the patient was again anæsthetized and carefully examined. It was found that the fistula was now reduced to a diameter of about one-quarter inch and was just posterior to the site of the internal meatus. The margins of this opening were denuded and interrupted sutures were passed to narrow the orifice in the hope of increasing the vesical control. The result of the operation was partially satisfactory, as the patient could remain dry while in the recumbent posture until the bladder became sufficiently filled to reach the level of the orifice at the neck of the bladder. By getting up to empty her bladder two or three times at night she was able to keep dry and she felt that a great gain over her previous distressing state had been accomplished. As soon as she stood erect, however, the leakage began to be troublesome. She was anxious for a further attempt to give her better control and she was re-admitted to the hospital and the next operation was done on January 9, 1922, when an effort was made to construct a urethra.

The inferior urethral wall was entirely absent, although the superior wall with its mucosa was present with fragmentary margins along each lateral wall. There was an entire absence of urethra or mucosa around the neck of the bladder at the site of the internal meatus. A scalpel was used to undermine the edges of each lateral wall of the superior urethra that remained, and the loosened flaps thus obtained were made to encircle a small rubber catheter which was passed into the opening in the bladder, and the edges were united with tanned gut sutures. The cut edges of the mucous membrane of the vestibule and anterior vaginal wall were then brought together over the new urethra with silkworm-gut sutures. The result of this operation was a complete failure as the tissues sloughed away, and the patient was discharged in the same condition as on her second admission.

She was admitted to the hospital for the third time on October 25, 1922, and I operated on November 8, 1922, and the result was most satisfactory.

In the first attempt I was guided by the method successfully employed by C. P. Noble (2), and in studying the problem at the second operation I determined to try the technique of Kelly, of making a tunnel under the vestibule and drawing through it a long flap, dissected from the anterior vaginal wall with its end left attached to the vesical opening (3). I had grave doubts as to my

[1] Figures 11 to 14 illustrate technique suggested by Dr. Lillian Farrar

Fig. 13 (at left). Flap pulled through tunnel.

Fig. 14. Tube sutured to the upper opening of tunnel.

being able to employ this ingenious procedure, because the anterior vaginal tissues from which I should have to obtain this flap were so thin, and were made up largely of scar tissue as a result of my original operation for the closure of the extensive defect in the trigone of the bladder. My fears were justified, as after I had succeeded in dissecting up a flap sufficient for my purpose, I had exposed the bladder wall underneath which was so extremely thin that it was not possible to leave it to granulate, and neither was it possible to approximate the lateral edges of the vaginal wound as the denuded surface was too wide.

The suggestion of Noble to use the labium minus as an attached flap in this region seemed worth trying and I, therefore, resolved to employ this tissue to cover this denuded and weakened area at the base of the bladder. After first making a tunnel with a scalpel behind the original site of the urethra and drawing the vaginal flap through it and suturing it in place, I accordingly incised the inner surface of the right labium minus at its attachment to the vestibule from the region of the clitoris to its base and then unfolded it by careful dissection. This gave me an ample flap attached by a broad base which was easily brought in place over the denuded area of the vaginal wall and was sutured in position with silkworm gut. The upper angle of the incision where the labia was detached was then sutured together. A very small soft rubber catheter (not a mushroom) was inserted in the new urethra and fastened with a suture.

The tissues healed without difficulty and the result was most satisfactory as the patient is dry in both the recumbent and erect posture and she can urinate without difficulty. We were particularly fortunate in establishing a good control in this case, probably due to some reenforcing sutures placed at the neck of the bladder at its junction with the new urethra.

Complete loss of the urethra is of comparative rare occurrence and there are not many cases in the literature. Noble states that he has heard Emmet say that in his large experience while he had succeeded in six or seven cases in restoring the urethra all of them were unsatisfactory and he would abandon further attempts. In both Noble's and Kelly's cases, pressure with a tampon or special pessary was necessary to insure control. Baker Brown seems to have had unusual success in three cases he has reported (4).

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CANCER OF THE UPPER JAW, ITS SURGICAL TREATMENT

By W. S. SCHLEY, M.D., F.A.C.S., New York

THE operability of any given case of malignant disease depends much upon the operator's experience, skill, and interest in the particular region in which the malignancy is located. It has been the experience of every surgeon to have had cases present themselves that had been pronounced inoperable yet when operated upon later were either cured or had long immunity from recurrence. Perhaps there is no region of the human body where this has been more true than in the superior maxillary region, even in the presence of extensive carcinomatous or sarcomatous disease.

The removal of the upper jaw for malignancy is still an operation of comparative rarity, yet there are few if any regions where extensive cancerous affection can be so satisfactorily dealt with and where the results of careful and thorough operative work are so remarkably good. Its apparently formidable character, and, finally, the seemingly inevitable possibility of disfigurement, in conjunction with the fact that it is questionable whether cure can be secured, are apt to halt both surgeon and patient. Some of these cases which were refused operation by men of surgical experience have, after subsequent operation, shown cures of 9, 7, and 5 years, and are still well.[1]

In the upper jaw, as with the lower, carcinoma is more frequent than sarcoma. Cancer of the upper jaw, and particularly that affecting the maxillary antrum, remains a local disease until quite late in its development. It does not tend to metastasize to the degree of cancer elsewhere. Extention to the cervical lymphatics occurs only at a late stage in carcinoma and not at all or only at a very advanced stage in sarcoma. The presence of infected lymph nodes is not in itself a contra-indication to operation. Such cases, after a thorough block dissection of the neck, will generally remain free of any further neck extension even with a renewal of the disease toward the orbit and nares. I have seen the neck remain clear even with extension of the disease into the pterygoid region. The creation of a distinct lymphatic

[1] The operative results are not as good as they should be, and this is largely due to two factors: First, to the late stage at which so many present themselves, often due to wrong early diagnosis, and, second, to the fact that the primary operation was incomplete.

Fig. 1. Line of incision for radical or partial removal of maxilla.

Fig. 2. Wide exposure of the bone before separation of its attachments. This incision may be greater or less, depending upon the requirements of the case.

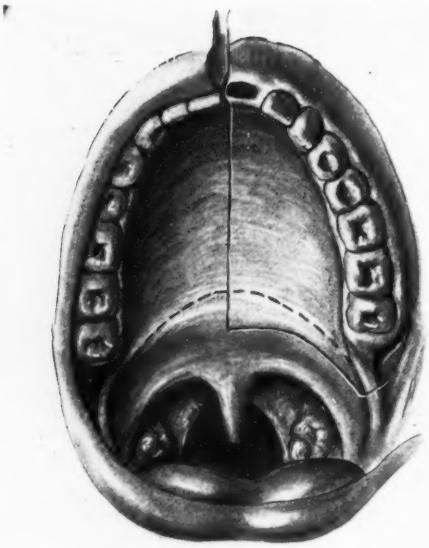


Fig. 3. Line of incision of hard palate, best made slightly to one side of the median line and soft palate then divided.

block is a matter of the greatest importance in all operations for malignant disease and erpecially in that affecting the mouth and jaws. The great majority of recurrences are local, where they are more amenable to further surgery or radiation or both, but the primary operation must be thorough

Fig. 5. The thin bony walls which separate the various sinus spaces offer remarkable resistance until late in neoplastic disease.

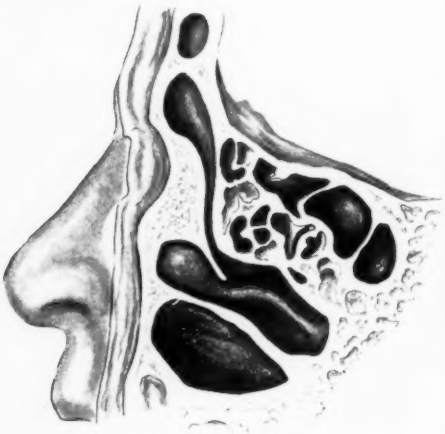


Fig. 4. The ethmoid cells are in close proximity and are not infrequently invaded with disease originating in the nasal mucosa or about the antral opening.

and well beyond the appreciable limits of disease, as these recurrences may be infinitely more difficult and at times impossible to deal with. The great danger is that there may follow the deep extension into the pterygoid muscles and region. As elsewhere our results in the main are directly proportionate to the care exercised upon first attack and to the extent of the field of operation. It would seem that there has been a tendency to limit the extent of operation for cosmetic and other reasons, but the greatest care should be exercised and the operation suited to the case. It is wiser not to be too conservative.

The operability is not always easy to determine; it is not invariably the extent of the disease that determines this. The character of the growth, apparent malignancy, chief situation and direction, the amount of extension and the condition of the patient should all be weighed. If the growth is confined to the maxilla alone or to the maxilla and the nares the necessary work is greatly simplified. With surface or deep extension toward the soft palate, faucial pillar, or involvement of the orbit or skin of the face, the difficulties are much greater but not by any means always insurmountable. A case reported herewith was of that type and is now alive and well 9 years after the last of two rather prompt local recurrences deep in the faucial pillar. When the disease has invaded the pterygoid muscles, and the sphenomaxillary space, it may be considered surgically hopeless.

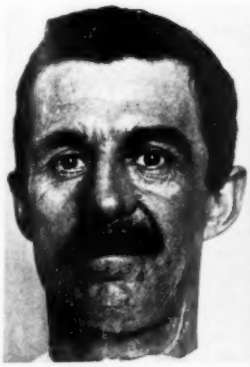


Fig. 6.

Fig. 7.

Fig. 7.

Fig. 6. W. G. Six and one-half years after operation upon the left side.

Fig. 7. Appearance of roof of mouth and prosthetic appliance worn by patient with comfort.

The preparation of the patient is important. Oral prophylaxis, especially with alveolar or palatal growths, must be thorough. The general condition of the patient and, where advisable, the hæmoglobin should be improved so far as possible during the time it is considered wise to delay. A careful skin cleansing insures rapid and accurate primary union of the skin and muscle flap, which is rarely involved even with a pronounced bulging from a growth within. Preliminary ligation or compression of the external carotid at or above the level of the superior thyroid is valuable in reducing blood loss, which is then reduced to a minimum. In a very radical excision of the upper jaw, I have seen blood loss as low as 4 ounces, by a very careful estimate.

Within my own experience and in my observation of the work of others in this country, patients have stood the operative work well and are out of bed upon the seventh day. The literature upon this subject is not great. As nearly as can be ascertained, the operative mortality during the last 20 years in the hands of all operators has been 12 to 15 per cent. Reports from the European clinics place it at from 20 to 30 per cent. This greater mortality abroad seems to have been due largely to a more extensive operation than is used in this country as well as to the inclusion of a wider operability. I believe that it is possible to employ all the continental thoroughness and still obtain the best American figure heretofore recorded, namely about 9 per cent, and better this by careful preparation. The earlier mortality was largely due to two factors, sepsis and hæmorrhage. Postoperative pneumonia contributed to many fatalities, as high as 72 per cent of the deaths in one record. Shock and exhaustion were frequently recorded, undoubtedly from excessive blood loss. We have controlled sepsis and hæmorrhage very completely, and pneumonia should be no more frequent than after any operation. We do not interfere with the muscles of deglutition as with excision of the lower jaw and have not that added source of danger. With good preparation and technique, the operative mortality is not large and there is but little disfiguring, as the photographs of average cases without prosthetic apparatus show. In carcinoma of the upper jaw the glands should be dissected whether palpable or not. This can be done at a prior sitting or at the time of the jaw excision, depending upon the condition of the patient. In sarcoma, unless glands are palpable, it is rarely necessary to dissect the neck, although it is a safe precaution. A very small percentage of cases will show cervical glands invaded upon the opposite side from that of the primary growth, and dissection of both sides of the neck has been advocated in all cases. In tumors of either upper or lower jaw, it is well to consider the possibility of hypernephroma, Paget's disease, or malignancy elsewhere.

For the operative work, moderate head elevation is more desirable. Patients are given a preliminary dose of morphine and atropine to compensate for the lighter anæsthesia. During the operation anæsthesia is induced in the usual way and is continued by means of nasal tubes passed to the pharynx. The atropine has the advantage of diminishing tracheal mucus. The pharynx may be lightly packed with broad gauze about the tubes so that nothing enters the larynx and trachea. The exposure of the operative field is best accomplished through the Ferguson incision, through the midline of the lip about the ala of nose toward the inner canthus of eye and then outward below the orbital margin, whether we are to do a partial or more complete excision. This incision gives excellent exposure and command and, with a care-

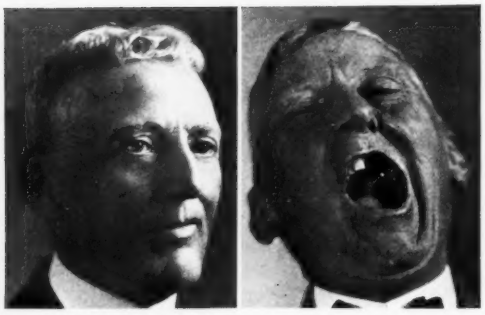


Fig. 8 (at left). R. B. Four and one-half years after operation on left side.

Fig. 9. R. B. Partial view of hard palate without prosthesis.

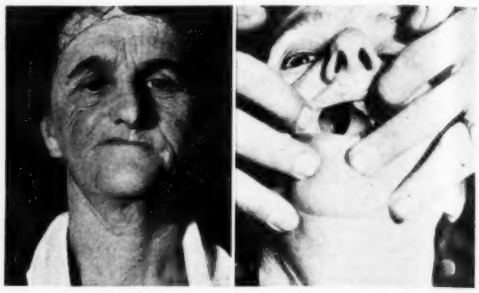


Fig. 10 (at left). M. B. One year after operation upon the right side.

Fig. 11. M. B. Partial view of hard palate with plate removed.

ful reparative suture, as the facial muscles are entirely unimpaired, a very slight defect results. The orbital plate as support for the eye should be left if possible, but with extension of the disease to the inner canthus of the eye the orbit must be cleaned out. The posterior wall with the pterygoid attachments can nearly always be left. With a growth completely limited to the antrum or to the antrum and contiguous portion of the nasal fossa, it is possible to remove only the anterior wall, or the anterior and nasal sides, and complete our excision by knife, spoon, or cautery, leaving the hard palate, which is of great advantage. This is especially permissible in sarcoma of the so-called giant-celled type where excision with the inlay of a good radium dosage is sufficient. With extensive squamous-celled carcinoma affecting the bone we are compelled to do radical work, and the greater the care exercised and the more thorough the excision, the greater will be our success.

Clean, sharp division of the hard and soft palatal structures well beyond the area of involvement produces the minimum trauma and allows a quicker reparative action. It is essential to work outside the limits of the growth to avoid any chance of implantation of the disease. The skin edges should be kept clean and the flap wrapped or covered with a moist warm gauze. The resulting cavity is packed with borated, or better, iodoform, gauze, which remains 5 to 6 days. Gauze wrung out of one of the milder antiseptic solutions replaces this at short intervals thereafter. Healing is more rapid than would be expected, although several months usually elapse before epidermization is complete, after which a prosthetic apparatus can be fitted. Soft food is taken on the third day, and there is no difficulty in maintaining nutrition. If the plate of the hard palate can be saved, the patient is more fortunate in that no apparatus will be necessary.

Among the most malignant cases are some that have been treated with local cauterization, incomplete excision, electricity, and ineffectual forms of radiation.

A number of cases which have been treated with radium and X-ray would, in all probablity, have shown better results if operation had been done as a primary procedure. The genuinely inoperable case should be given the maximum radiation with the hope that it may become operable or respond to radiotherapy. I should not be inclined to favor pre-operative radiation in operable cases.

Suppurative conditions of the antrum may mask a co-existent or causative malignancy. A number of the malignant growths of this region start in nasal or antral polypi, and the portion removed for diagnosis does not always show the cancer. Such was the condition in one of the series of cases shown 4 years ago. All biopsy specimens removed until the last failed to show malignancy. At operation the antrum was filled with carcinoma and the disease had involved the ethmoid cells. This patient is alive and well today, 4½ years after operation. The orbital plate and eye were saved. The photograph will show the condition at present. The disease was squamous-celled carcinoma.

It is especially suggested to the laryngologist and rhinologist, and to the general practitioner and dentist as well, that certain recurring polypoid conditions of the nares and about the antral orifice, as well as persistently ulcerated conditions of the mucosa about the teeth, should be regarded with suspicion. The X-ray will often help in a determination of the condition of the antrum. There are great variations in the malignancy of tumors

and of individual resistance, but our greatest chance of success in this region still lies in the careful eradication of the primary focus together with removal of the regional lymphatics. Postoperative radiation with radium will be of help, and, as has been said, with so-called giant-celled sarcomata may be all that is necessary after a limited resection.

The operation today is not productive of great shock, loss of blood, or delayed convalescence, in the average case, and I feel offers renewed hope and encouragement in this field of surgery where some brilliant successes are recorded in the past and an increasing number will be in the future. The cases reported in November, 1918,[1] are all alive today. The greatest length of time that has elapsed in those cases has been 9 years and the shortest 4½ years. I believe that they may be accepted as cures, for the recurrences that take place are not long delayed. There has been no operative mortality in the series or in cases operated upon since. All but one are alive today. The patient who succumbed 14 months after operation to a wide involvement of the orbital region refused the additional sacrifice of the eye with a clearing out of that region at the time of the primary procedure. Had she done so her chances for recovery would have been multiplied many times. Any involvement of the periosteum necessitates the removal of bone beneath. In addition to the cases of 1918, the histories in brief of three other cases, all traced and seen recently, are given herewith. Another operated upon in 1917 has not been traced and is not included.

W. G., Hosp. No. 115319, S. Chief complaint when seen was inability to breathe through left nostril and the presence of a swelling of the left cheek. Six months previously, the patient had noticed difficulty in breathing through the nose with the mouth shut. He went to a "nose specialist," who removed a portion of tissue for examination. That side became completely closed shortly thereafter. He was told that the trouble was sarcoma and was given radium treatments. The prognosis was bad. The swelling of the cheek remained. Patient sought further advice. He presented a distinct bulging of the cheek on the left side and the left nostril was occluded by a red, rather firm mass attached upon the left side. Transillumination showed antral opacity. The teeth were intact and firm. Family history was negative except that two brothers had had nasal polypi removed. Wassermann negative. No palpable lymphatics. The patient's general condition was good and his hæmoglobin 70 per cent. Operation, September 9, 1916—Cervical glands upon the left side were removed and the external carotid ligated. The maxilla was excised according to technique described. The antrum was completely filled with neoplasm which had invaded and completely filled the left nostril extending up to the ethmoid. The bony walls were involved, and the central portion of the orbital plate was removed.

Diagnosis: giant-celled sarcoma, inflammatory reaction in lymph nodes. The disease was evidently of rapid growth but not of metastasizing variety of this type. Patient left hospital 15 days after operation and has had no X-ray or radium treatment. It is a purely surgical cure. He has had no recurrences or metastases and is alive and well 6¼ years after operation. The photographs show the present condition and prosthetic apparatus.

R. B., Hosp. No. 130308, S. For a year before being sent for operation, this patient had had recurring polypi removed from the left side of his nose. He was sent for radium treatment for this condition. A portion of tissue was removed close to the antral orifice and showed squamous-celled carcinoma. The left side of the nose was almost closed. Antrum illumination showed opacity. Glands were palpable upon the left side. Patient in very fair condition, with a hæmoglobin of 65 per cent. Wassermann negative. The operation as described was done. The disease had entered the ethmoid cells, which were opened and cleared out. The antrum contained a solid mass of neoplasm and the bony walls were invaded. A portion of the orbital plate was removed in addition. The cervical lymphatics removed at the same time were free from invasion. This patient has had no recurrences or metastases and is alive and well 4½ years after operation. He has had no postoperative X-ray or radium treatment.

Diagnosis: squamous-celled epithelioma of the jaw. The tumor consists of very much inflamed, œdematous connective tissue into which extend long tubules of squamous cells with pearl formation. The tumor has invaded the bone of the jaw, inciting a considerable rarefying osteitis. This tumor apparently arose from a point at or near the antral orifice. (Figs. 8 and 9.)

M. B., first seen March 15, 1922. Referred by Dr. E. R. Lampson of Hartford, Connecticut. For the last 8 months patient had had some mucopurulent discharge from the right nostril and the last 2 months the discharge had become blood-stained. For 6 months he had noted increasing difficulty in breathing through the right side of nose, which was almost completely occluded by a mass with attachment apparently on the right side. There was a distinct bulging of the cheek. A portion removed showed squamous-celled carcinoma. Patient in very fair condition, Wassermann negative.

Operation, March 16, 1922. The maxilla was excised, leaving the orbital plate and the greater part of the pterygoid portion. Neck dissection and ligation of the carotid had been done at a prior date. The disease filled the antrum and extended above the middle turbinate in the nose and to within a centimeter and a half of the eustachian orifice posteriorly. The cervical and submaxillary lymph nodes were not invaded. This patient has gone but a year since operation but has shown no recurrence or metastasis. The photograph taken a year after the removal of her jaw shows the appearance of the face. She has a well-fitting prosthetic apparatus and has no difficulty with mastication and deglutition. (Figs. 10 and 11.)

No one of these patients had had previous sinus or antral trouble or history of a chronic rhinitis with the exception of the one with the recurring nasal polypi. None had had trouble with the teeth of the upper jaw upon the side of the disease. No one of these had postoperative radium or X-ray treatment. I believe that postoperative radium and X-ray treatment are at times indispensable adjuvants, and when either is employed the application must be thorough.

[1] Annals of Surgery.

MAJOR UROLOGICAL SURGERY UNDER SACRAL AND PARASACRAL ANÆSTHESIA

By OSWALD SWINNEY LOWSLEY, A.B., M.D., F.A.C.S., New York
From the Urological Department, James Buchanan Brady Foundation, of the New York Hospital

STIMULATED by a report on "Sacral Anæsthesia, as applied to Genito-Urinary Surgery" by Parker Syms at the New York Academy of Medicine in February, 1921, that method of inducing anæsthesia has been utilized from time to time in the department of urology at the New York Hospital until we have now developed a method which seems to give excellent anæsthesia in almost every case.

F. Cathelin[1] and Durant (1902) used sacral anæsthesia for the purpose of treating grave neuralgias, sexual neuroses, and incontinence of urine. The former first used plain water, salt solution, and later added cocaine, novocaine, codeine, or morphine. By this method Cathelin reported 49 per cent of the cases of incontinence of urine cured; 35 per cent materially benefited; and 4 per cent failures. He failed in his attempts completely to anæsthetize the sacral nerves in humans but was successful in dogs. A. Laewen[2] used 20 to 25 cubic centimeters of 1½ to 2 per cent novocaine and placed the patient in the sitting posture for some minutes after injection, with the idea of retaining the solution in the lower end of the vertebral canal. O. Gros,[3] recommended the addition of sodium bicarbonate, which he states permits the solution readily to penetrate the nerve sheaths. Strauss prepared his solution by the addition of sodium sulphate which he maintains prevents the decomposition of adrenalin, which he also uses. Hertzler recommends the uses of quinine and urea using 60 to 90 cubic centimeters of 6/10 per cent solution. B. Lewis and L. Bartels[4] reported 48 successful cystoscopies out of 68 attempted and D. R. Pickens[5] reported 81 out of 100 attempted. Splendid work on this subject has been done by Thompson of Galveston who follows the method described by M. L. Harris.[6] Albert J. Scholl, Jr.[7] used sacral anæsthesia successfully in 140 cystoscopies out of 150 in which it was used.

The patients upon whom this type of anæsthesia was first used by us were mostly cases in extremely grave condition upon whom a perineal prostatectomy was performed. They will be mentioned in detail later. In the last series all operations in which the anæsthesia was applicable were done under sacral. This includes operations upon the prostate, seminal vesicles, and urethra. In operations within the scrotum the sacral must be reinforced by blocking off the cord as it emerges from the inguinal canal.

METHOD OF ADMINISTRATION

The following is the routine procedure which we have developed and attempts to deviate from it have caused unsatisfactory results in some way or other.

The patient is prepared for operation in the usual manner as regards purgation enemata, etc.

[1] Les injections spidurales. Paris, Baillière, 1903.
[2] Zentralbl, f. Chir., 1910.
[3] Muenchen. med. Wchnschr., 1910.
[4] Surg., Gynec. & Obst., 1916.
[5] J. Tennessee M. Ass., 1916.
[6] Tr. Am. Surg. Ass., 1917.
[7] J. Urology, 1921, August.

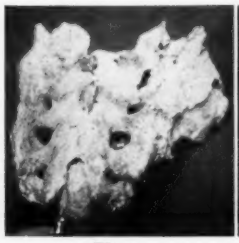


Fig. 1.

Fig. 2.

Fig. 3.

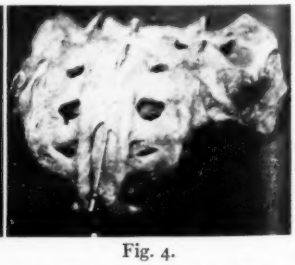


Fig. 4.

Fig. 1. This sacrum shows the usual location of the hiatus.

Fig. 2. This sacrum has its hiatus very high up—a common anomaly.

Fig. 3. The roof of this sacral canal is entirely lacking.

Fig. 4. The hiatus of this sacrum is so compressed that a needle can barely be introduced when it is entirely freed from all organic matter.

One hour before going to the operating room an opium suppository (gr. i) is inserted into the rectum. Just as he starts for the operating room he is given a hypodermic of 7 minims of Magendie's solution. Upon arrival he is placed upon his elbows and knees or upon his abdomen on the table. The skin is then infiltrated at the point where the needle is to be inserted, the skin first having been sterilized in the usual manner.

The operator then palpates the coccyx, and sliding his finger above this bone reaches the lower part of the sacrum and is usually able to palpate the sacral hiatus without difficulty. The sacral horns adorn the lateral borders of a triangle of which the hiatus is the apex. A 6-inch needle is inserted through the anæsthetized skin and into the sacral canal by puncturing the ligament which covers its lower end. After penetrating this ligament the needle is easily pushed in 1½ to 2 inches. It has to be guided carefully otherwise it will impinge on bone and must, of course, be deflected. One learns to tell by the ease with which the needle passes and the direction it takes whether it is in the canal. One of the directions the needle may take is just over and to one side of the roof of the canal. This error is detected by the direction of the needle and the fact that it passes with difficulty. One can also check up on this position, if improperly inserted, by the fact that as soon as the injection is started the tissue at the end of the needle will infiltrate with the solution.

The sacrum has a great many variations in different individuals and a careful study of the osteology as well as the course of the nerves is a necessary preliminary investigation.

The needle having been inserted into the canal, one observes its end carefully to see whether either blood or spinal fluid runs out. In the event of this complication the needle is withdrawn to a point where it ceases to appear and the injection made. If the solution runs in easily one is sure that he is in the canal. If, however, the injection is made with difficulty one is quite sure that the needle is not in the canal and the tissues over the sacrum are observed for infiltration.

We have been using 30 cubic centimeters of freshly prepared 2 per cent novocaine solution injected into the canal without the addition of sodium bicarbonate solution. We have not used adrenalin in the injected solution because we have preferred to have it in reserve in case of collapse from the toxicity of the drug.

The injection into the canal is extradural and presumably elevates the dura from the bone under the pressure used. In this procedure one may safely use a quantity up to 60 cubic centimeters provided the solution is not toxic. We then inject 1 per cent solution of novocaine into the first, second, and third sacral foramina on each side in accordance with the method of Labat. The foramina are located rather easily by passing the needle into the depression just below the transverse processes and by pointing it mesially and slightly upward ones needle usually enters without great difficulty. From 5 to 10 cubic centimeters of 1 per cent novocaine solution is injected into each foramen the needle being withdrawn in order to distribute it in the entire length of the foramen.

The patient is then placed on his back and 20 minutes by the clock is allowed to elapse before the operation is begun. By this time that part of the patient which sits on a saddle including the scrotum, urethra, and bladder should be thoroughly anæsthetized, if the injection is successful.

Scholl has timed the appearance of anæsthesia as follows:

	Minutes
Ano-scrotal region	4
Posterior surface of scrotum and penis	10
10 to 12 centimeters laterally on inner surface of thighs	10
Sphincter ani, sacrum, and buttocks	10
Anterior urethra	12
Meatus and internal sphincters last to become anæsthetized, maximum anæsthesia in	20–25

We have found that by starting to operate too soon the patient will often feel pain and such an apprehensive state of mind will be produced that every movement will cause complaint. On the other hand, if one waits until a thorough anæsthesia occurs, the patient goes through operation without a protest.

DESCRIPTION OF CASES

First Series (6 Cases)

In this series novocaine, 40 cubic centimeters of 2 per cent solution, was injected into the sacral canal only. This type of anæsthesia was used because it was believed that the patients, in most instances, could not stand an inhalation anæsthesia of even gas or oxygen.

The cases included one Young's punch operation, one suprapubic prostatectomy, one perineal prostatectomy for carcinoma of the prostate, and three perineal prostatectomies for adenomatous hypertrophy of the prostate. On account of the frail condition of Cases 2 and 3 mentioned above, operation under inhalation anæsthesia would have been impossible. After six operations

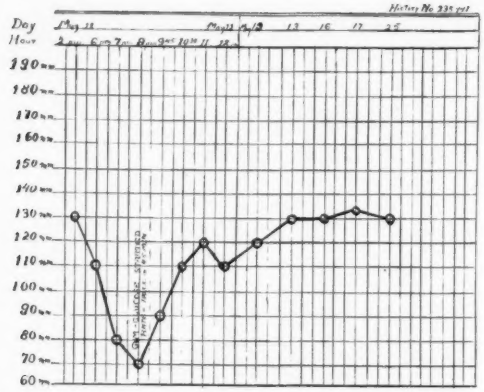


Chart 1. This case had a serious slump in blood pressure following prostatectomy under gas-oxygen anæsthesia. Relieved by gum glucose.

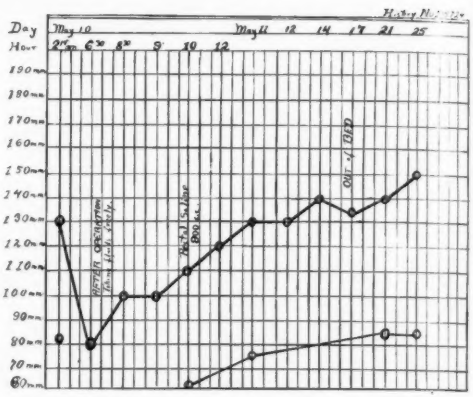


Chart 2. Operation on this patient was started under sacral anæsthesia and finished under gas-oxygen. Profuse bleeding occurred throughout operation. Recovery without gum glucose.

were performed as above, sacral anæsthesia was given up because it was not a painless procedure and no cases arose which made such an anæsthesia imperative. Case 2 is of sufficient importance to outline briefly.

Patient, married, admitted January 25, 1921; discharged April 14, 1921. Diagnosis: enlarged prostate. Operation: suprapubic prostatectomy.

At age of 12 patient had stone in bladder which was removed through urethra. Twenty years ago he had nonspecific urethritis of 2 weeks' duration.

Present illness. Patient in uræmia and unable to answer questions. History elicited from his family. One year ago he had frequency and pain on urination. Two months ago he suffered an attack of acute retention and his health since that time has failed until now he is unable to work. He has severe vesical tenesmus, no hæmaturia, but complete retention of urine for past week.

On January 26, a suprapubic cystotomy was done under local anæsthesia, and suction drainage applied. Patient suffered no postoperative hæmorrhage or vomiting.

January 30: There is some congestion in posterior region of right lung.

February 12: Patient out of bed practically all day but has few moist râles in left chest.

February 15: Temperature 101 degrees. Chest clear.

February 18: Flatness in posterior region of left lung. 4.4 cubic centimeters of bloody fluid aspirated with relief to patient.

March 1: Again aspirated but no pus or fluid obtained.

March 3: X-ray shows no fluid in pleura.

March 6: Patient out of doors for walk.

March 19, 1921: Suprapubic prostatectomy under sacral anæsthesia. Six grains novocaine. The abdominal wound was very well anæsthetized over whole area. Infiltrated with novocaine. The prostate was easily removed. Patient stood operation well. One hundred cubic centimeters of gum glucose solution was given intravenously during operation and aromatic sprits of ammonia after operation overcame shock. No postoperative hæmorrhage or vomiting. Patient made an uninterrupted recovery and was discharged from the hospital April 14, as completely cured. Was seen at return clinic in February, 1923, and has returned to work and feels perfectly well.

SUMMARY OF CASES

Since February 3, 1923, 76 cases have been operated upon under sacral and parasacral anæsthesia according to the method described above. Fifty of these were perineal prostatectomies, four prostatotomies for abscess, five seminal vesiculectomies for abscess of the seminal vesicles, three Young punch operations for enlargement of the subcervical group, five urethrotomies for stricture, one hydrocele, the latter performed at the Lexington Hospital, and eight cystoscopies. All of these cases were entirely successful except six. In one of the latter, viz., the seminal vesiculectomy, it was necessary to give a few whiffs of ether during the last 5 minutes of the operation. In another one, that of a man 86 years of age upon whom a perineal prostatectomy was performed, a little gas or ether should have been used for about the same length of time. The other cases were only moderately uncomfortable and when asked after the operation whether we hurt very badly, "not so bad" was the usual answer. In the case of excision of the hydrocele sac the cord had to be blocked off with novocaine as it emerged from the external ring, as the skin of the scrotum only was anæsthetized by the sacral and parasacral anæsthesia. In two of the unsuccessful cases we attempted some deviation from the routine method of procedure. Parasacral infiltration alone is not sufficient. One per cent novocaine used in the sacral canal was also a failure.

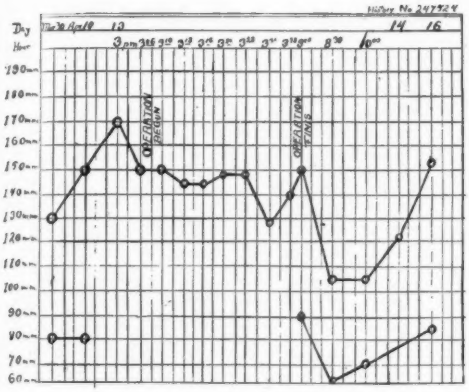


Chart 3. A typical blood pressure chart of a case of prostatectomy under sacral anæsthesia. Rarely has the blood pressure dropped below 100 millimeters mercury.

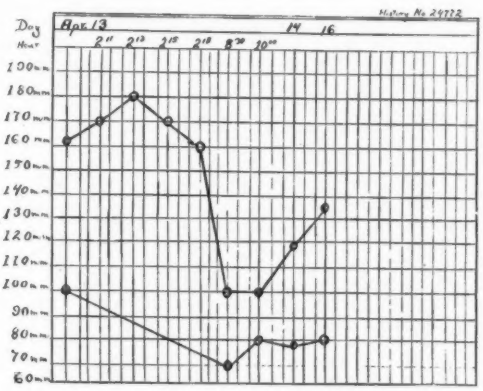


Chart 4. Shows the typical slump after a Young punch operation under sacral anæsthesia. It is not so extensive as with any inhalation anæsthesia.

In the seventy thoroughly successful cases the operation apparently passed by unnoticed, except in a few instances in which the patient stated that there was no pain but he could feel a pulling sensation. Three or four of the patients actually dozed off during the operation. An important observation is that the bleeding during prostatectomy, which is fairly profuse by every method, is much less than that noted when gas-oxygen anæsthesia is used, due presumably to the fact that the blood pressure is not nearly so high when the patient is under sacral anæsthesia. Five-minute readings were made during several cases, and typical curves are shown in Charts 1, 2, and 3.

UNTOWARD SYMPTOMS

Two cases have had short periods of excitement. One had spasmodic contractions of the legs lasting about one minute. Two others became flushed and somewhat confused temporarily. Most of the cases have an increase in pulse rate and slight increase in blood pressure which lasts throughout the operation.

The untoward symptoms in our cases appeared immediately after the injection was given into the sacral canal. Adrenalin is always held ready for use in case a collapse occurs. We believe in holding it in reserve as a stimulant in case of necessity and hence do not use it in the original solution injected.

E. Zweifel[1] reported a death from cardiac and respiratory paralysis due to the injection of 0.8 gram of novocaine into the dural space. His needle had penetrated the dural sac.

[1] Muenchen. med. Wchnschr., 1920.

B. Kroenig,[2] reported a case in which the novocaine was injected into the sacral vein. This was followed by a partial respiratory paralysis.

LENGTH OF TIME AFTER INJECTION DURING WHICH ONE MAY OPERATE

As stated above it is our invariable custom to wait for full 20 minutes before beginning to operate. The anæsthesia seems to be deepest at about 30 minutes and continues to be entirely satisfactory for two hours after injection. Dr. Parker Syms[3] makes it a practice to wait for about an hour before beginning to operate. He believes that the anæsthesia lasts for several hours.

In one case, that of a seminal vesiculectomy, we felt that the anæsthesia was wearing off at the end of 1 hour and 20 minutes and were obliged to give a few whiffs of ether during the last 5 minutes of a long difficult operation performed by one of my associates, Dr. Delzell.

POSTOPERATIVE COURSE

We have not yet had a death in any of our cases of either series. In the first series were two cases that could not have been operated upon except by means of sacral anæsthesia as they were in no condition to withstand inhalation anæsthesia of any sort. In the last series of 70 patients there is one such case. We have felt for some time that blood-pressure readings are much more important in postoperative observations than any other feature of the immediate recovery. It has been a surprise and delight to observe this

[2] Operative Gynaekologie, Leipzig, 1912.

[3] Internat. J. Surg., 1921, June.

series of cases. In none of the second series has the blood pressure dropped below 100 millimeters mercury, and all of them have shown a tendency to rise at the danger period, about 6 hours after operation. We have not found it necessary in any of these cases to give stimulation to the circulatory system either by means of drugs, intravenous infusion of gum glucose, or any other substance.

The general appearance of the patients on the day following operation by this method is surprisingly good and it would seem that the shock to the entire body mechanism is very considerably reduced by avoiding inhalation anæsthesia.

There have been no late developments such as headache, paralysis, or other alarming effects. Thus far our patients seem to improve from the zero postoperative hours, 6 to 10 after operation, without interruption.

One of our cases developed a cellulitis of the tissues over the scrotum which was due apparently to the improper sterilization of the novocaine used.

CONCLUSIONS

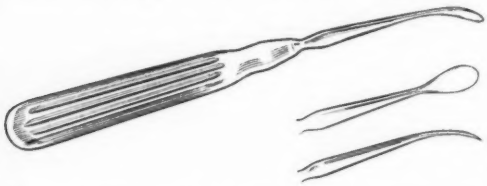
Our series is much too small to draw general conclusions. Our observations and the experiences of others lead us, however, to believe that:

1. Sacral combined with parasacral anæsthesia is the anæsthesia of choice in performing major urological operations *per perinæum*, particularly prostatectomy.
2. In perineal prostatectomy under this type of anæsthesia there is less bleeding and less shock than there is with any inhalation anæsthesia.
3. It is apparently safe and effective if given properly.

AN INSTRUMENT TO FACILITATE BUNION OPERATIONS AND SESAMOIDECTOMY

By PHILIP LEWIN, M.D., Chicago

THIS paper is not concerned with the symptoms, pathology, and indications for hallux valgus operations or sesamoidectomy. It is a brief description of an instrument to expedite



these operations. The instrument was described in a paper in the April, 1918, issue of Surgery, Gynecology and Obstetrics. Dr. J. L. Porter and the writer have used it in a great many hallux valgus operations with gratifying success. The writer has since applied its use to the operation of sesamoidectomy and has found it extremely useful. It is well known how difficult it might be at times to dissect a sesamoid from its tendinous attachments on the plantar surface of the first metatarsal head. The technique of the operation is as follows:

An incision is made along the edge of the sesamoid and that structure is grasped by means of an Allis forceps or preferably a Backhaus forceps. The herein illustrated dissector is then easily passed around the bone which can be quickly shelled out. The shape of the instrument corresponds very closely with that of the sesamoid.

THREE AIDS TO RENDER THE CONDUCT OF LABOR MORE SCIENTIFIC

By JOSEPH B. DeLEE, M.D., F.A.C.S., Chicago

THE terms obstetricians use to convey to others the ideas of the mechanism of labor, e.g., the degree of engagement of the presenting part, the degree of rotation, the stage of dilatation of the cervix, are very vague and unscientific. They are especially unsatisfactory for permanent records and for teaching students.

One of the most important elements of a given diagnosis is the determination of the degree of engagement. The usual terms—"head floating"; "head engaged," "at the outlet," etc., certainly do not convey the same impression to any two different minds.

In order to express in understandable scientific language the exact station of the head, the writer has devised the plan shown in Figure 1.

A vertical coronal plane is imagined passing through the spines of the ischium. This plane is divided into centimeters and numbered as shown in the illustration. The interspinous line is zero. The centimeters above are minus, those below, plus. If the lowest portion of the head (not the caput succedaneum) has reached the spines, i.e., just engaged, we say the head is "engaged at zero, O." If it is higher we say it is "not engaged, minus 1, or —2, —3," or shortly, "head —3." If it has passed "O" we say it is "engaged, plus 1 or +2, +3," etc., or shortly, "head +3."

Naturally the application of this method is subject to the rules governing engagement imposed by the type of pelvis and the nature of the presentation, to all of which it is easily adaptable.

The need for a clear objective method for conveying to others the degree of rotation of the presenting part, especially in teaching students the mechanism of labor, and in explaining to graduates the intricacies of forceps operations, has led the writer to devise the procedure shown in Figure 2. The usual method of designating the various positions, O. L. A., O. D. P., etc., is good as far as it goes. The plan suggested refines this part of our art. The pelvis is laid on a circle with radii marking the degrees. The pubis is zero "O", the sacrum, 180°. With this plan O. L. A. would be O. L. 45°, O. D. P. — O. D. 135°, O. L. T. — O. L. 90°, etc. One can thus designate every stage of rotation, e.g., O. L. 15°, O. D., 110°, O. L. 175°, etc., and the figure stated represents the arc the occiput must travel to complete anterior rotation.

Of all expressions those referable to the stage of dilatation of the cervix are the most vague and questionable. "The effacement is half complete," "the cervix admits 2 fingers," "the os is the size of a dollar," "the palm of the hand," etc. These examples show how unscientific and circumlocutionary our present terms are. To obviate this and to enable the teacher to convey to the pupil, and the examiner to record, with objective clarity, the findings of rectal and vaginal examination, the writer developed the plan shown

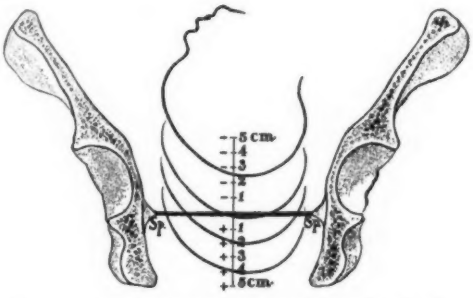


Figure 1. Determination and designation of the degree of engagement.

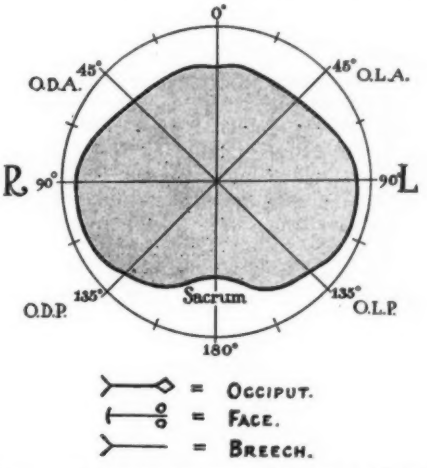


Figure 2. Determination and designation of the degree of rotation.

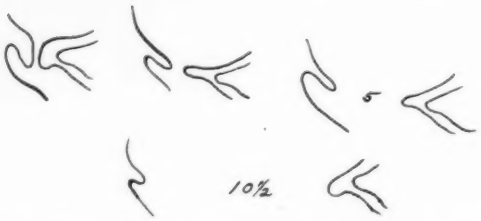


Figure 3. Pictorial representation of effacement and dilatation of cervix.

in Figure 3. These simple sketches are easily learned and in a few seconds all the needful information regarding the effacement and dilatation of the cervix can be conveyed to others and at the same time recorded. By putting in the numerals 2, 4, 7, 9, in the sketches, the growing enlargement of the cervix can be followed.

All three of these procedures have been in daily use at the Chicago Lying-in Hospital and Dispensaries for over 5 years and are giving increasing satisfaction all of the time. To render them practicable, a centimeter ruling and example sketches of the cervix are printed upon the margins of the history sheets and several reproductions of the graduated circle (Figure 2) are inserted where the results of the examinations are to be recorded.

THE USE OF FAT TO PREVENT SUTURES CUTTING INTO PARENCHYMATOUS ORGANS BY UNDERPINNING

With Special Reference to the Suture of Nephrotomized Kidneys

By EDWIN BEER, M.D., F.A.C.S., New York

SOME three years ago, in discussing the closure of accidental or operative wounds of the liver, spleen, and kidney, I called attention to the fact that sutures could be underpinned or supported with fat or fascia so that bleeding could be well controlled without any danger of the sutures cutting into the sutured organ. I had used this method in kidney work for several years and found it particularly ideal in decapsulated kidneys, in which sutures so regularly cut through the parenchema and may be of little value in controlling bleeding. In looking up the literature at the time, I was interested to see that Da Costa, on page 1426 of his *Modern Surgery*, 1919, illustrates a very similar method of underpinning with catgut strands, in closing nephrotomy incisions. He calls this method which prevents the cutting through of the suture "Stellwagen's method of suture." According to the illustration in Da Costa's book, the suture is applied slightly differently from the method employed by me, and perhaps with the suture identified as Stellwagen's, more kidney parenchyma is destroyed than by the method to be described. I have used this method a large number of times, and in view of the limited amount of kidney necrosis induced by the use of this stitch, I have made use of it regularly, not only in decapsulated kidneys but in kidneys still covered with their capsule. Recently E. Hagenbach[1] has described a method of suturing the kidney which is practically identical with the method described by me, and expresses great satisfaction with the results. The accompanying illustration shows very clearly the different steps of the operation, the illustration having been made by one of my house surgeons almost 3 years ago.

[1] Ztschr. f. urol. Chir., 1923, Feb. 17.

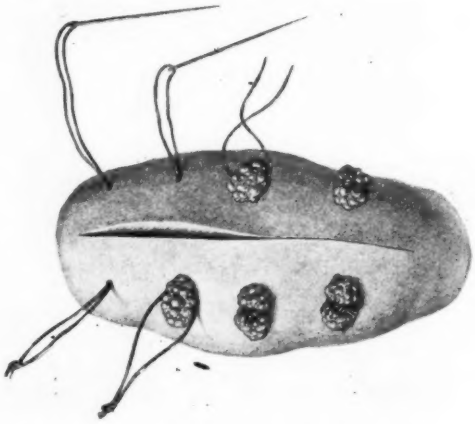


Figure 1. Technique of underpinning chromic gut (with fat) hæmostatic sutures following nephrotomy.

To close the incision in the kidney, or for that matter the spleen or liver, some fat from the adjacent wound is excised and cut into fair-sized masses. A fairly heavy chromic stitch with the two ends of the stitch tied together is passed deeply through the part to be sutured, so that the kidney, or other organ, has a double thread of chromic gut running through it. Before pulling the loop up to the organ that is being sutured, one piece of fat is slipped under the loop and then the suture is drawn tight. On the other side of the organ where the needle has been brought out, between the two loops of chromic gut, another piece of fat is placed and over this the two ends of chromic gut are tied after removing the needle. This knot can be pulled up as tight as required to control the bleeding, and as the stitch is underpinned on both sides, there is very little chance to cut into the parenchyma. In view of the fact that no tissue is throttled by the passage of the suture, as is the case in mattress sutures, very little kidney parenchyma is destroyed by this method of closure. In addition to these deep sutures, the edge of the nephrotomy incision is closed with either continuous interlocking or interrupted chromic gut sutures.

In such wounds as above described, it is to be highly recommended and is regularly used in kidney surgery by my staff. Up to date there has been no opportunity to apply it to wounds of the spleen or liver, but from the experience obtained in kidney surgery, one would expect very satisfactory results in the other organs.

INTRAPERITONEAL HÆMORRHAGE IN THE NEWBORN FOLLOWING THIES' METHOD OF RESUSCITATION

By M. P. RUCKER, M.D., and S. W. BUDD, M.D., Richmond, Virginia
From the Departments of Obstetrics and Pathology of the Johnston-Willis Sanatorium

JOHANN THIES[1] has described a method of resuscitation for the apparently dead newborn and those in white asphyxia. His investigations and those of Welker, Schueckling and Seitz have shown that in the newborn there is a comparatively small amount of blood (one-fifteenth to one-nineteenth of body weight), and with delayed tying or clamping the cord, the quantity of blood in the infant's body is increased some 25 per cent. In two cases of stillbirth, Thies found as much as two-thirds of the fetal blood in the placenta and umbilical cord. It occurred to him that it would be advantageous in many ways (raising the blood pressure in the right side of the heart, improving the circulation in the lungs and in the centers in the medulla), to milk this blood from the placenta into the fetus. He states that each stroking of the cord toward the body is followed by a strong pulsation of the heart that is often visible. He has used this method of *Autobluttransfusion* for 10 years and reports his results in the last 35 cases. Of these apparently dead babies, 34 were resuscitated. Six of them, however, died in the first week.

Thies' theory is an attractive one, but that the method is fraught with some danger, the following case would seem to indicate. The father had several years before his marriage a rather disconnected treatment for syphilis, and it was a question in the mind of the referring physician whether he had been completely cured. The mother was in excellent health. Her blood Wassermann was negative, as were also the physical, pelvic, and urine examinations. This was her first pregnancy. She went into labor shortly after the administration of castor oil. It was a breech presentation, and an easy extraction was done under ether anæsthesia, shortly after the cervix was completely dilated. When the buttocks appeared, it was noticed that the testicles were greatly enlarged. The child was in white asphyxia, and as much blood as possible was milked from the cord into the body. The cord was then clamped and cut and an attempt was made to resuscitate him with a lung motor. This was unsuccessful, and the child went into rigor mortis while we were still working upon him.

Autopsy showed approximately 200 cubic centimeters of clotted blood in the periotoneal cavity. Unfortunately the abdominal incision severed the umbilical vein in several places, so that it was impossible to say from just where the blood came. The brain and other organs were markedly ischæmic, but showed no other changes. The testicles showed a myxomatous degeneration, such as is seen in congenital syphilis. There was marked hyaline degeneration in the blood vessels of the placenta.

[1] Thies, Johann. Zur Behandlung des Scheintodes beim Neugeborenen, Zentralbl. f. Gynaek., 1920, lxiv, 607.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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ALLEN B. KANAVEL, M.D. ..... Associate Editor

NOVEMBER, 1923

AUTO-INFUSION OF BLOOD FROM THE SPLEEN IN CASES OF SPLENECTOMY

THE operation of splenectomy is still attended with a fairly high mortality. To reduce this mortality to a minimum is the object of all surgeons within whose sphere of work such operations are performed. The high mortality is mainly due to the pathological changes in the blood, and to the more remote pathological conditions induced by the altered state of the blood. In order to diminish the risk of operation, patients have been transfused with whole or citrated blood once or many times before operation, and gratifying results have followed.

In many of the conditions necessitating removal of the spleen the organ is found to be enlarged, sometimes considerably. The amount of blood such an enlarged spleen contains must represent a considerable proportion of the patient's total blood. Even though the plan is adopted of compressing the splenic artery for a few beats before clamping the pedicle or ligating the vessels, the volume of blood still retained in the enlarged spleen would represent a large proportion of his total blood. The loss of so much blood to a patient already suffering to some extent from anæmia, even though one or several transfusions of blood may have been performed, might be the means of turning the scale of the balance against him, after the operation of splenectomy.

In July, 1922, my friend and former colleague in the Meath Hospital, Dr. Henry Stokes, suggested to me the consideration of reinfusing the blood from the spleen into a patient on whom I intended to operate. The case was that of a man about 50 years of age who was suffering from advanced Banti's disease. The spleen was greatly enlarged, and cirrhosis of the liver was marked. I thoroughly approved of the idea, and on the morning of the operation a solution of sodium citrate (160 cubic centimeters of a 3.8 per cent solution) was prepared, half the amount being placed in a sterile basin. Directly I had secured the pedicle of the spleen between clamps Dr. Stokes took charge of it and held it over the basin containing the citrate solution. The clamps were removed and the blood flowed from the spleen into the basin. A little gentle circumferential pressure facilitated the flow. When it was seen that the volume of blood was considerable, the remaining 80 cubic centimeters of citrate solution was added. The citrated blood was then transfused into the patient's median basilic vein while I closed the abdomen.

The total amount of fluid transfused was more than 800 cubic centimeters. The net result was that the patient was placed in bed with at least 650 cubic centimeters of blood of which he would otherwise have been deprived. The procedure certainly greatly improved his chances of recovery.

Several reports of re-infusion of extravasated blood in cases of ruptured tubal pregnancy, traumatic rupture of the spleen and liver, and injury of the mesenteric vessels, have appeared in literature during the last 2 years, but I have not seen this idea of Dr. Stokes' suggested.

Blood shed into the tissues, even into the peritoneal cavity, rapidly undergoes changes, and clotting quickly takes place. For this reason I feel sure that most of the fluid re-infused in these cases is merely serum with the hæmoglobin dissolved out of the red cells. It has no oxygen-carrying power and is not altogether devoid of danger, whereas, in a case of splenectomy the blood cannot be altered in any way, since it simply flows from the severed splenic vessels into the sodium citrate solution.

I believe this method of re-infusion of the blood from the spleen will eventually become a routine part of the operative procedure of splenectomy performed for all conditions other than traumatic rupture, torsion of the pedicle, or malignant disease.

WILLIAM TAYLOR.

DUBLIN TODAY

ON a recent trip abroad I went first to Ireland. I wished to see again this country of four and one-half million people whose influence has been world wide. Ireland not only has furnished Great Britain men who have made her armies and navies famous, but she has given the world great liberators, men of fiery patriotism whose commemorative statues adorn the countries of their adoption, in the north and south, and in the east and west. Sons of Ireland have enriched immeasurably literature, the sciences, and the arts. Unfortunately, while the services the Irish have rendered to other countries have won them undying fame, at home they have suffered for a thousand years from continuous political disturbance which has marred the history of their country. Truly free at last in essentials, the Free States of Ireland have a responsible government of their own choice corresponding closely to that of Canada, Australia, New Zealand, and South Africa. After taking a conspicuous part in every great war of civilization, Ireland is now successfully coming through her first civil war, under the leadership of Timothy Healey, the Irish patriot who for forty years has fought for Irish Home Rule in the Parliament of England.

The greater part of my time in Ireland was spent in Dublin. On entering the city one is impressed with the wreckage of many of the beautiful old buildings designed by the great architect Grandon. Fortunately, the University of Dublin, with its beautiful campus, and dignified buildings in the heart of oldest Dublin, was not damaged during the recent civil riots. Trinity College, on this campus, coequal with Oxford and Cambridge, with which it exchanges students, is more than 330 years old. The University Medical School, housed in fine buildings, enrolls about four hundred students, all of whom are of collegiate grade.

The National University of Ireland, founded about 25 years ago, has beautiful buildings, which are now to a considerable extent occupied by the Government because of the destruction of the public buildings which were devoted to governmental purposes.

The medical school in connection with the Royal College of Surgeons and the Royal College of Physicians was established in 1790, and in it many of the great medical men of Ireland have been trained.

In spite of the trials and tribulations of war-scourged years the medical men of Dublin are well organized and hard at work.

The hospitals are well equipped and have in operation excellent three-year training schools for nurses. There are a number of hospitals in Dublin but none large, the average having approximately one hundred and twenty beds. They are all essentially charitable institutions, although many patients are partly self-supporting, so far as the hospitals are concerned. The Meath Hospital is one of the oldest. It was here that Graves did his work on goiter, and Stokes made his discoveries regarding the heart and circulation. In the Stevens Hospital, Colles did his early work in connection with the fracture that bears his name. In the hall of the Royal College of Physicians there are a number of fine portraits and statues, among which are to be found those of these three pioneers in medicine. The Royal College of Surgeons has notable buildings worthy of the great work carried on by the society.

I greatly enjoyed my visit with the Honorary Fellows of the American College of Surgeons in Dublin. Sir Thomas Myles has retired to his favorite amusement of yachting, so far as his devoted clientele will permit him. He justly achieved a great reputation in surgery, and as a speaker he possesses eloquence of a high order. Sir William Taylor, regius professor of surgery of the University of Dublin, is connected with Sir Patrick Dun's Hospital, where he conducts most interesting clinics. Sir William is a gifted teacher and surgeon. I heard him give a graphic description of infantile intussusception, stressing the sudden crying out of the child, the pallor, the vomiting, and the explosive movements from the bowels. In none of his cases has he had recurrence after operative reduction. In performing splenectomy in cases of anæmia he immediately transfuses the free blood in the spleen to the patient. He has had noteworthy success in handling cases of acute obtruction of the bowels, using a high enterostomy, with two tubes, for the purpose of emptying the toxic contents of the bowel, and of nourishing the patient.

Sir Robert Henry Woods at Sir Patrick Dun's Hospital demonstrated excellent results following maxillofacial surgery. He has performed a large number of laryngectomies for malignant disease, with a low percentage of mortality and a high percentage of excellent functional results. Sir William I. de Courcy Wheeler, president of the Royal College of Surgeons of Ireland, comes of a celebrated family of surgeons. For many years his father occupied the chair of surgery of the medical school of the Royal College. Sir William is a surgeon of great skill, and has in a high degree the friendliness and kindness of heart so characteristic of his race.

I greatly enjoyed a visit to the Rotunda Obstetrical Hospital, of about one hundred and twenty beds, which, for half a century, has maintained its reputation as the most famous obstetrical hospital in the world. The Master of the Rotunda, Dr. Ernest Hastings Tweedy, who always emphasized that parturition is a physiological process, has just retired. He has made many great contributions to the scientific literature of obstetrics, especially in connection with eclampsia and sterility. Dr. Gibbon Fitzgibbon is his worthy successor to the headship.

W. J. Mayo.

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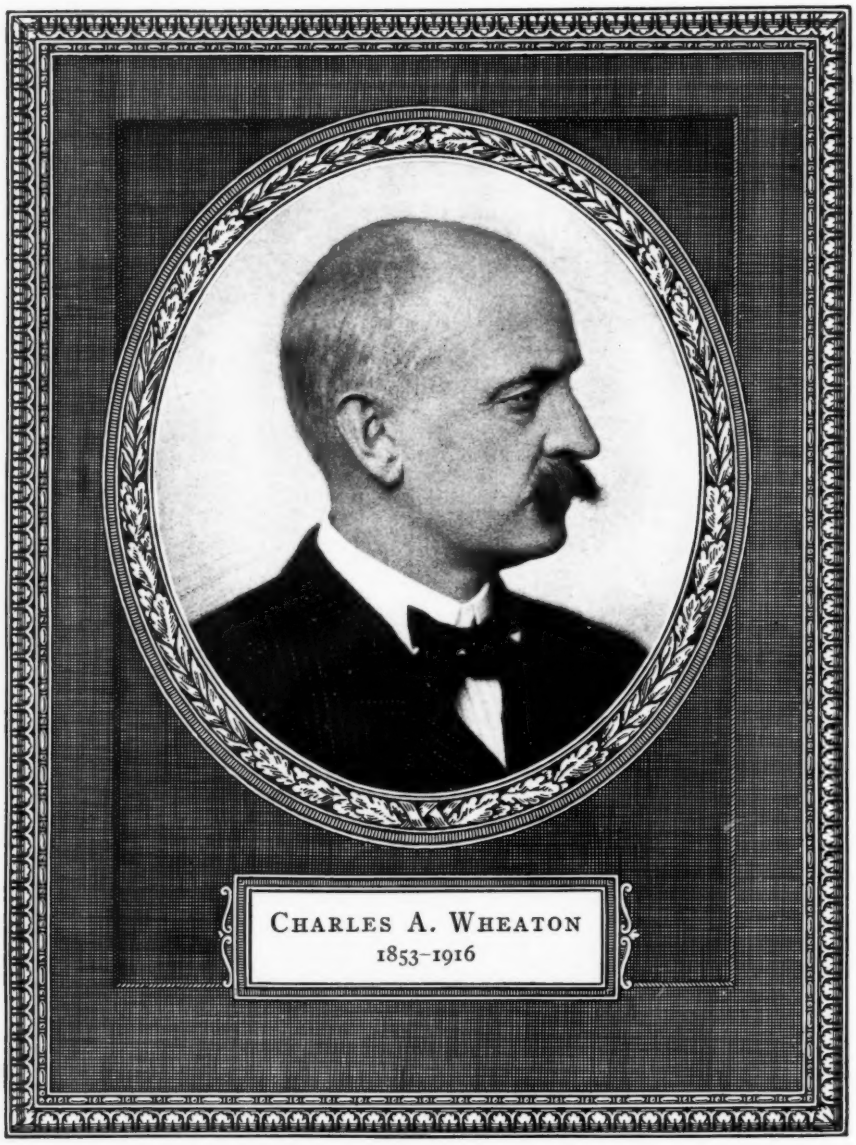

CHARLES A. WHEATON
1853–1916

MASTER SURGEONS OF AMERICA

CHARLES A. WHEATON

DOCTOR CHARLES A. WHEATON was born in Syracuse, New York. He was one of a family of fifteen who immigrated to Minnesota. His father settled at Northfield.

His education was gotten in the local schools of Northfield and from his older sisters, two of whom were teachers. He was not a college man. His father was a literary man, being an editor for many years. As a boy he was surrounded with literary people. As a consequence, his love for literature was pronounced even at an early age and continued throughout his entire life. While still young he conceived the idea of becoming a surgeon, but for financial reasons he was unable at once to begin his medical education. He became a railway express messenger in order to earn enough to take him through college and while acting as such he carried in his grip Gray's *Anatomy* and Yeo's *Physiology*, both of which he mastered at odd hours in his work. After a few years he had accumulated sufficient funds to enable him to matriculate at Harvard Medical School. After graduating from Harvard he spent 2 years in the Massachusetts General and Boston City Hospitals, before coming to St. Paul in 1879 to practice his profession.

He early allied himself with Dr. J. H. Stewart, an old practitioner, an able man and extremely popular. Through this alliance Doctor Wheaton was enabled at once to plunge with enthusiasm into the practice of his chosen profession and very soon was able to cull from a large general practice surgical material of a very general character. With this material at hand he early demonstrated his great surgical ability.

As a general practitioner as well as a surgeon, he was especially noted for his clinical ability and for his remarkable personality, a personality which inspired absolute confidence on the part of his patients and of his confrères.

As a diagnostician he had no superior. His interpretation of clinical signs was exact to a remarkable degree and, he depended throughout his entire career more upon clinical signs than upon laboratory or other aids in diagnosis. He deplored the growing tendency of the younger men to depend too much upon laboratory and X-ray or machine-made diagnosis.

He was a pioneer of the Northwest in antiseptic and aseptic surgery and stood head and shoulders above any other man of his community.

As one of the founders of the present Medical Department of the University of Minnesota, he was an enthusiastic teacher for a quarter of a century. His lectures were carefully prepared, often illustrated by his own drawings, and always couched in classical language. He was an indefatigable reader and had at his tongue's end the literature of any subject on which he lectured. To those fortunate enough to hear him, his lectures were a privilege and an inspiration.

Always progressive, he was foremost in the organization of many medical societies in the city and throughout the Northwest. He was ethical to a degree and he hated anything in medicine that smacked of the charlatan or of quackery.

He was charitable to his professional brothers who had not had the opportunity; he could not condone dishonesty or carelessness. For the fads and fancies of surgery he had little patience and was outspoken in condemnation of all such.

At the operating table he was master of every situation that might arise. His anatomical dissection while operating was a joy to the onlooker. His courage and boldness were remarkable. His quickness and deftness was unsurpassed. His experience in surgery was tremendous, and it is to be deplored that throughout his active professional life he was too busy to record his cases or to contribute, to any great extent, to the literature of the day. He himself often deplored his inability to find time to write. His great fund of knowledge, acquired from his own long experience and through his study of the surgical masters, commanded the respect of the entire profession of the Northwest.

He was much sought as a speaker in the many medical and surgical societies of Minnesota and adjoining states. Outside of the medical profession his great vocabulary and command of language made him much sought as a postprandial speaker. Few men equalled him as an after-dinner talker and story teller. His stories were always apropos and their verbal embellishment was a work of art which could be appreciated only by those who had heard him.

He was a genial, companionable man, fond of the good things of life and happiest when extending hospitality and good cheer to his friends. He was a lover of nature, and would often steal away from his active work to spend a few days or hours in the fields or on the streams. During the latter part of his life he was in ill health and spent most of his time in the South during the winter, and on the beautiful Brule River in the summer.

No man of his time was so universally beloved and respected as was Dr. C. A. Wheaton and no man was more deserving.

Whether they know it or not, or whether they appreciate it if they do know it, it remains a fact that the trail he blazed through the wilderness of ignorance in surgery has made it comparatively easy for those of the generation following him. He was a self-made man and he put surgery on the map in the Northwest. His memory and his accomplishments will endure forever.

JOHN T. ROGERS.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN GYNECOLOGY AND OBSTETRICS

By GEORGE GELLHORN, M.D., F.A.C.S., St. Louis

MEDICAL works, as a class, rather generally lack that indefinable quality which in books of a different character—fiction, travel, autobiographies—we call *charm*. The medical author, as a rule, feels himself hedged in by too many inhibitions. Chief among them is the desire for strictest objectivity, and where every word has to be weighed carefully lest it lay itself open to criticism, spontaneity is naturally lost to a certain degree. By speaking of himself exclusively in the third person throughout the length of a fat tome, the author achieves a definite, though rather tiresome impersonality but, on the other hand, he foregoes the direct touch with the reader.

Particularly gifted writers know how to break these somewhat traditional fetters without detriment to the scientific value of their works, and make of the acquisition of knowledge a matter of keen enjoyment. I well remember from my college days how the textbook by Fritsch rendered the study of gynecology a genuine delight.

To this category of medical books with a distinct and pleasing personality belongs the new work by Kerr on gynecology.[1] There is a directness and simplicity of diction which makes you feel that you are listening to a genial host while he is sharing his wide experience with you. The personal note is still further enhanced by the numerous case abstracts wherein successes are not overaccentuated and mistakes or failures frankly admitted.

In its general outline the book follows, on the whole, the usually accepted plan. The first and largest part, entitled Clinical Gynæcology, contains twenty chapters in which anatomy, methods of examination, physiology, general symptomatology, and the pathology of the various organs are discussed. Interspersed are chapters, by able collaborators, on subjects regarding which the author "did not feel competent to express definite opinions." This refers to embryology, nervous disorders, venereal diseases, anæsthesia, and transfusion.

The second part deals with medical treatment and remedies, and the third with operative gynecology. This second part is rather short, which is all the more surprising as the author everywhere exhibits a wise conservatism which, contrary to prevailing tendencies, makes full use of non-operative methods. This is very evident, for example, in retrodisplacements where the much-ridiculed pessary is accorded its legitimate place. It is interesting to read that in mild degrees of uterine prolapse, excellent results were obtained by paracervical injections of sulphate of quinine. "The essential detail in the treatment of endometritis is not curettage, but disinfection of the uterus." That Kerr uses pure carbolic acid for this purpose without attempting to prevent excessive cauterization by subsequent neutralization, may be objected to by those of us who have observed atresia following the application of this agent. Fibroids discovered during pregnancy call for palliative treatment wherever feasible. "In many instances the pregnancy is the only one the patient is to have; it is her only chance of securing a child. Everything possible, therefore, must be done to conserve the uterus during pregnancy; only if one is driven to operate should one do so." Of course, there may be cases where radical surgery represents true conservatism as, for instance, in certain cases of dysmenorrhœa in rudimentary or infantilistic uteri where no remedy avails and hysterectomy should be done. "This treatment may appear heroic, and naturally is only employed if the uterus is extremely small. But it is infinitely preferable to allowing such women weary years of suffering, with no possible prospect of relief until ovarian activity ceases." I may add, parenthetically, that nowadays radiotherapy would take the place of surgery.

I have given these quotations principally to illustrate the humane attitude of the author whose heart goes out to the patient and who, himself a master in surgical technique, yet espouses non-surgical methods wherever they seem to serve best the interests of the patient.

There is another point which is strongly emphasized in this book—the close and physiological relationship between gynecology and obstetrics, and the obvious disadvantage under which the pure gynecologist or the general surgeon labors who is not experienced in both these branches.

It is but natural that one dissents here and there from the author, but it is unnecessary to dwell on such more or less unimportant details. There is, however, one incorrect statement which should be modified in the next edition, namely, that spinal anæsthesia can not be employed if the patient is to be placed in the Trendelenburg position.

[1] Clinical and Operative Gynæcology. By J. M. Munro Kerr, M.B., C.M. London: Henry Frowde and Hodder & Stoughton, 1922.

The twelve full-sized colored plates are masterpieces of pictorial art. The numerous line drawings are less perfect. The illustrations of operative procedures will suffice for the operator with personal surgical experience; to the beginner they would be deficient in any complicated operation such as the Spinelli operation for inversion, the Wertheim technique in cervical cancer, or the Baldwin method for an artificial vagina. Despite its 832 pages, the book is not heavy, and the printing is excellent.

THE practitioner should, at the bed side, think in terms of pathological physiology. The necessary premise is a knowledge of the pathologico-anatomical changes which underlie all manifestations of disease. The physician will then be able properly to analyze the complaints of the patient, to recognize the connection between cause and effect, to arrive at the correct diagnosis, and to institute a rational treatment. This is the *Leitmotiv* of the small book in which Lahm has embodied his post-graduate lectures on gynecology at the well-known woman's clinic in Dresden.[1] The author covers the entire field of gynecological diseases by starting from the principal symptoms: discharge, bleeding, pain, amenorrhœa, and pressure signs due to mechanical factors. In each of these discussions the morbid alterations of the normal structures and the resulting changes of function are presented, which, in their turn, explain the outward manifestations. In by far the great majority of gynecological diseases, local causes can be found to account for the symptomatology. In some, for instance, in certain forms of discharge and in most of the instances of amenorrhœa, constitutional anomalies or disturbances of the general condition are at work. Pathological bleeding, unless caused by local sources such as polyp, submucous fibroid, carcinoma, or infectious processes, is due to dysfunction of the ovaries. Pain, in most instances, must be interpreted as the response of the central nervous system to local stimuli and will cease when the latter have been found and eliminated.

This analytical method of teaching is particularly appropriate in post-graduate instruction because it accurately reproduces the mode of approach in actual practice. Having used it myself in the class room for many years, I naturally find myself in full sympathy with the book and I feel that it deserves wide circulation. It will prove distinctly helpful to students and practitioners in the correlation of book learning and practical application; and it is full of valuable suggestions to teachers who are actively interested in the movement for more extended post-graduate instruction in this country.

TO the clinician who struggles through the maze of an ever increasing, and often contradictory, literature on endocrinological subjects, the book by Peritz[1] will appeal as a timely and reliable guide. The volume presents, in about 250 pages, a very clear exposition of the difficult matter and discloses, on the part of the author, not only a judicious consideration of the literature but also extensive personal experience. The chapter devoted to the sexual glands is almost twice as long as any of the chapters dealing with the other endocrine glands. This indicates that the author, who himself is a neurologist, fully realizes the all-important rôle the gonads play in the organism. In fact, it was from the sex glands that the teaching of endocrinology had its origin. It is of interest to read that 20 years before Brown-Séquard reported the startling observations made on himself after the injection of testicular extract, Berthold, of Goettingen, had performed autotransplantations of testicles in roosters and had, in his deductions, anticipated the achievements of the most recent times.

The gynecologist will find this chapter replete with valuable information. There are, for instance, the experiments of Steinach and Takakusu which prove the marked influence of ovarian hormones upon the entire organism and, in particular, on the central nervous system. The intricate subject of the determination of the sex is explained upon the basis of Mendel's laws and the discoveries by Henking and Wilson of the behavior of the chromatosomes in the germ cells. Variations and disturbances in the partitition and arrangement of these chromatosomes also offer an explanation, heretofore lacking, of certain malformations and developmental defects. A detailed discussion is devoted to the question of the interstitial gland. Peritz denies its existence in the human ovary and believes that in the species where these interstitial cells actually exist, they serve merely to store up and transmit the hormones produced by the follicle cells. (In this connection it is interesting to recall the recent studies by Doisy in the *Journal of the American Medical Association* which conclusively prove the follicle cells to be the source of the ovarian hormones.) Steinach's "rejuvenation" is explained by an increased absorption of sexual hormones and is only of very temporary benefit; it has no analogy in the female. Hermaphrodism, homosexualism, and infantilism have a very definite endocrine causation which is interestingly discussed.

A very illuminating chapter deals with the relation of constitution and internal secretion, and there again we meet with the decisive effect of the sexual hormones upon the central nervous system, the so-called erotization of the psyche. It may be accepted that men with a strongly developed sexuality are energetic, determined almost to the point of brutality, while the eunochoid shows a diametrically different behavior. That disturbances of the other endocrine glands influence directly or indirectly the sexual functions of the female organism—with which, for the moment, we are

[1] DIE PATHOLOGISCH-ANATOMISCHEN GRUNDLAGEN DER FRAUENKRANKHEITEN. By Prof. Dr. Wilhelm Lahm. Published by the Staatliche Frauenklinik, Dresden, 1922.

[1] EINFUEHRUNG IN DIE KLINIK DER INNEREN SEKRETION. By Prof. Dr. G. Peritz. Berlin: S. Karger, 1923.

mainly concerned—is repeatedly pointed out. As an example, the frequent occurrence of acromegalic signs in pregnancy may be cited.

These quotations may suffice to indicate the interesting qualities of the book. A further point of commendation is the clear distinction the author makes between facts (of which there are relatively few) and theories (of which there are many), and the practical applicability of these facts in the treatment of disease.

MEDICAL literature for nurses has been enriched decidedly by the appearance of two new books on obstetrical subjects. The book by Plass[1] reflects the attitude of Johns Hopkins and, in particular, the teachings of Williams. It is a complete treatise on obstetrics, quite comparable in outline and illustrations to any good textbook for medical students save that complicated and mooted questions have been condensed or omitted, and that the essentials of the knowledge of obstetrics have been put into as simple language as possible without the confusing detail. One feels entirely in sympathy with the author when he claims that nursing is constantly rising to a higher plane, and progressively more learning will be required of all in the profession; and we also agree with the author that the best educated nurse is one of the best mediums by which the public may be educated. So well has the author succeeded in his task that only favorable comments can be offered.

There is this fundamental difference between obstetrics and most of the other branches of medicine that we have to deal, in the majority of instances, with *normal* individuals whose health we wish to preserve. The object of obstetrics, therefore, is, in its last analysis, that of prophylaxis.

This purpose is even more apparent in the second book, which has emanated from the University of Oregon Medical School.[2] Moore presents to the nurse the present state of our knowledge concerning the nutrition of mother and child. Emphasis is placed on breast feeding, vitamins, and the mineral content of the diet, and only those procedures are described which have been tested and proven of practical value in personal experience. The sick child is only casually considered, as this volume is not intended to replace the physician in the home. "In all illnesses, acute or chronic, medical advice should be sought. The purpose of the book is to teach mothers how to render their families less subject to disease. As prevention is better than cure, our ideal should be the avoidance of unnecessary ills by proper diet from infancy." The greater part of the book, therefore, deals with the newborn child, both full term and premature, including his antenatal nutrition by means of the appropriate diet of the mother during pregnancy. There are, further, several chapters on diet and general hygiene for older children, which should prove highly interesting and instructive. A number of menus and recipes concludes the volume.

It is a pleasing thought that in far distant parts of our country forces are at work which make for the promotion of the welfare of mothers and children.

IF it is important to instruct nurses in the preventive aspect of obstetrics and obstetrical pediatrics, it is equally important to disseminate such knowledge among the laity. In a previous review[1] I have dwelt at length on the desirability of such steps and, for this reason, welcomed any new attractive books on these subjects. The best vehicle in this educational propaganda is, of course, books since they will reach where the spoken word and demonstrations can not penetrate. Whether it is possible, or even desirable, to combine instruction to nurses *and* mothers in *one* book, is, however, highly problematical. The *Nursery Guide for Mothers and Nurses*[2] by Sauer is a case in point. There is nothing whatever to be said against the tenor of the book which strives to impress the person in charge of an infant with her great responsibility. The advice given is perfectly sound and in conformity with the best medical standards. The two classes of readers, however, for whom the book is intended, require different treatment. What seems almost too brief for nurses, may be sufficient, if not superfluous, for mothers. To the latter, for example, the paragraph on blood examination with its reference to the normal white blood count and hæmoglobin determination, is bound to be unintelligible and, therefore, unnecessary. This and similar statements are minor defects compared with the introductory remarks where tuberculosis, syphilis, and gonorrhœa are discussed in three short paragraphs. These may, perhaps, mean something to the trained nurse who has had previous instruction in these diseases; to the mother they are merely terrifying. I would suggest that this first page be eliminated in any future edition.

IT is, probably, much more satisfactory to keep instruction of nurses and mothers separate, as has been done by Miss Van Blarcom. "To the Baby, upon whose wellbeing depends the future of the race"—thus the author inscribes very appropriately her guide for prospective mothers,[3] a companion book of her *Obstetrical Nursing* which was recently reviewed in these pages. I wish to call particular attention to this latest addition to the literature on popularized medicine. The two chapters on anatomy and physiology, and embryology, respectively (though these terms do not actually appear in print), are really masterpieces in their simplicity and are bound to convey to any

[1] OBSTETRICS FOR NURSES. By Everett Dudley Plass, M.D. New York and London: D. Appleton and Co., 1922.

[2] NUTRITION OF MOTHER AND CHILD. By C. Ulysses Moore, M.D., M.Sc. Including Menus and Recipes by Myrtle Josephine Ferguson, B.S. Philadelphia and London: J. B. Lippincott Co., 1923.

[1] SURG., GYNEC. & OBST., 1918, xxvii, 545.

[2] NURSERY GUIDE FOR MOTHERS AND NURSES. By Louis W. Sauer, M.A., M.D. St. Louis: C. V. Mosby Co., 1923.

[3] GETTING READY TO BE A MOTHER. By Carolyn Conant Van Blarcom, R.N. New York: The Macmillan Co., 1922.

woman of average intelligence some conception of her organs and of what is going on during the baby's intra-uterine existence. This newly acquired knowledge must also impress her with the realization that by taking care of herself she is also taking care of the baby, and thus make her eager to co-operate with the physician in his prenatal care. The chapters on the prenatal and postnatal care of mother and child are quite on a part with those mentioned and, like these, distinguished by a clarity and directness which leaves nothing unexplained. "If every expectant mother, no matter what her status or location, followed the simple, practical advice which this book offers, the rate of illness and death among our mothers and babies would be materially lessened." This is the statement made by J. C. Edgar and F. W. Rice in the introduction, and I heartily concur with their sentiments. The physician, I strongly feel, would do well to read this little book and to recommend its study to his patients.

OBSTETRICIANS are coming to realize that they can learn much from pediatrics, just as all of us have learned much from pathology. The pediatrician has, or should have, to deal with the obstetrician's results. This book by Hess[1] is of as vital importance to both specialties as are the recent works by Ehrenfest and von Reuss.

Obstetricians are prone to refer premature infants to pediatricians with greater alacrity than that with which they refer other babies. And pediatricians receive them with misgivings, not to say alarm. Both will welcome Hess' book as an authoritative, readable source of information on this particularly difficult and tricky variety of newborn. The material is not only admirably illustrated but also well arranged, making it readily accessible to "him who runs."

Part I discusses etiology, physiology, and pathology; Part II, the nursing and feeding care; Part III, the general diseases incident to prematurity; Part IV, the points influencing prognosis.

As special researches add to the accumulation of medical facts, books of this sort are bound to increase in number. And it is well that it should be so; for the specialist, instead of spending his substance on highly expensive "sets" and "systems," will be able to select his own library on his own specialty, thus minimizing his proportion of unread printed matter. P. J. WHITE.

[1] PREMATURE AND CONGENITALLY DISEASED INFANTS. By Julius H. Hess, M.D. Philadelphia and New York: Lea and Febiger, 1922.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

DISEASES OF THE RECTUM AND COLON AND THEIR SURGICAL TREATMENT. By J. Lockhart-Mummery, F.R.C.S. (Eng.), M.A., M.B., B.C., (Cantab.) New York: William Wood and Company, 1923.

THE HEART; ITS PHYSIOLOGY, PATHOLOGY, AND CLINICAL ASPECTS. By Dr. Selian Neuhof, B.S., M.D. Philadelphia: P. Blakiston's Son & Co., 1923.

SURGERY OF THE SPINE AND EXTREMITIES. By R. Tunstall Taylor, B.A., M.D., F.A.C.S. Philadelphia: P. Blakiston's Son & Company, 1923.

BIOLOGIE UND PATHOLOGIE DES WEIBES, EIN HANDBUCH DER FRAUENHEILKUNDE UND GEBURTSHILFE. By Josef Halban, and Ludwig Seitz. Berlin: Urban & Schwarzenberg, 1923.

PHYSICAL DIAGNOSIS. By Richard C. Cabot, M.D. 8th ed. New York: William Wood and Company, 1923.

L'INDIVIDUALITA DEL SANGUE NELLA BIOLOGIA, NELLA CLINICA E NELLA MEDICINA LEGALE. By Prof. Leone Lattes. Messina: Guiseppe Principato, 1923.

COLLECTED PAPERS OF THE MAYO CLINIC, ROCHESTER, MINNEAPOLIS. Edited by Mrs. M. H. Mellish, vol. xiv, 1922. Philadelphia and London: W. B. Saunders Co., 1923.

DIE METHODEN DER LOKALANAESTHESIE IN DER BAUCHCHIRURGIE UND IHRE ERFOLGE. By Prof. Dr. Hans Finsterer. Berlin: Urban & Schwarzenberg, 1923.

A TREATISE ON THE DISEASES AND INJURIES OF THE RECTUM, ANUS, AND PELVIC COLON. By J. Rawson Pennington, M.D., F.A.C.S. Philadelphia: P. Blakiston's Son & Co., 1923.

THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY IN THE WORLD WAR. Vol. I—The Surgeon General's Office. Prepared under the direction of Maj. Gen. W. M. Ireland, M.D., Surgeon General of the Army, by Col. Charles Lynch, M.C., Lt. Col. Frank W. Weed, M.C., and Loy McAfee, A.M., M.D. Washington: Government Printing Office, 1923.

AMERICAN COLLEGE OF SURGEONS

HOSPITAL STANDARDIZATION REPORT FOR 1923

Including List of 1786 General Hospitals of 50 or More Beds in the United States and Canada Which Meet the Minimum Standard of the College

THE American College of Surgeons has just completed the sixth annual survey of hospitals in the United States and Canada. The results of this survey give evidence of steady progress toward hospital betterment and an increasing interest in the hospital standardization movement. Not only are the medical profession and the hospital people themselves vitally interested, but the public is developing a widespread belief in this effort for improved and highly efficient care of the sick.

Since the year 1918, when the American College of Surgeons first actively undertook the standardization of hospitals, there has gradually developed a new era in hospital service. This era is characterized by the development of more efficient institutions standing for the utilization of every means known to medical science for the best possible care of the patients. A definite standard has been established whereby hospitals may measure their efficiency in terms of service to the sick and end-results. The standard is now well beyond the experimental or trial stage. After six years of its application in large numbers of institutions on this continent, those charged with its promotion find no reason for altering any of the procedure laid down therein. This standard is based on a service so broad as to embrace the activities of every person who has anything whatsoever to do with the care of the patient—the hospital "perspective"—on whom the accumulative services of the institution must be focused. Every person in a hospital organization, no matter what their status may be, has a definite responsibility and share in the proper care of each individual patient and in the obtaining of the best possible result.

WHAT HOSPITAL STANDARDIZATION IS

Hospital standardization is an international movement including in its scope all general hospitals of fifty beds and over in the United States and Canada. It is carried on by the American College of Surgeons whose membership includes at present over 6000 surgeons in both countries as well as a number from South America. One of the outstanding features in the progressive program of the College is the movement for better hospital service, more widely known as hospital standardization. This movement, through the application of its inherent principles and by means of an annual survey, aims at establishing and maintaining in hospitals an organized personnel working as a group in the best interests of the patient. It demands that there be provided the necessary facilities for scientific diagnosis and treatment and that these facilities be utilized under competent direction. It requires that there be a careful and accurate recording of all data concerning each patient. This is necessary in order that there be a thorough study and investigation of each case to insure (a) an early, accurate, and comprehensive diagnosis, (b) the correct and effective treatment, (c) the best possible end-result. It is the desire of the College that, through the carrying out of this program, every individual requiring hospital treatment, regardless of race, color, creed, or social status, shall receive the benefits of the most up-to-date and scientific procedures known to modern medicine. This is a humanitarian service with the basic idea that our hospitals are conducted entirely for the benefit of the patient.

There is no desire to interfere with the individual initiative of any hospital. The standard set is the minimum requirement. Each institution is encouraged not only to reach that standard but go as far beyond it as possible. The requirements laid down are fundamental. They are the basic principles which are absolutely necessary to make the hospital a scientific institution, capable of rendering the best service to the patient, to the public, and to the profession.

The minimum standard sets forth certain clear cut and definite requirements which deal chiefly with the conduct of the hospital in the interest of the patient. These requirements may be briefly summarized as follows:

A. *The organization of the medical staff.* A hospital, meeting the minimum standard, must

have a competent and ethical medical staff to which certain duties are assigned as follows: (a) the drawing up of rules and regulations governing the professional work of the hospital, (b) the supervision of the professional activities of the hospital in order that the highest degree of efficiency may be maintained, (c) the carrying out of staff conferences at regular periods, and (d) the rendering of every assistance possible to the administration or management in the development and promotion of the professional work of the institution.

B. *The providing of case records.* In order to insure competent and satisfactory investigation and results in every case coming under treatment in a hospital, it is absolutely necessary that accurate records be provided. "A hospital without records is like a clock without hands, still running but providing no information to tell whether it is right or wrong." An accurate record is of inestimable value not only to the patient, the doctor, and the hospital, but also in the advancement of scientific medicine and research. Our hospitals owe to future generations records of present experiences. What we know of scientific medicine has largely been left to us by the masters of the past.

A physical accounting is required in every thoroughly competent hospital. Otherwise the institution is operating blindly without any definite realization as to its actual efficiency. This accounting can be carried out only when the findings, the facts, and conclusions on every case are properly recorded. Moreover, the record must have behind it the spirit of honesty and sincerity and be a filtration of scientific facts leading to a definite conclusion.

C. *The providing of diagnostic and therapeutic facilities.* In this regard special reference is made to the laboratory and X-ray services. Those departments, when efficiently organized and under competent direction, are of inestimable value, both in making a diagnosis and in carrying out treatment. The minimum standard does not only require that these facilities be available for the benefit of the patient in the hospital but that they be competently and scientifically utilized whenever required.

WHY HOSPITAL STANDARDIZATION COMMENCED

The American College of Surgeons was founded in 1913 with high ideals and certain professional requirements for Fellowship. Very early the surgeons found that their working environment in the hospitals was not in keeping with the ideals and objectives set forth by the College. Many hospitals at that time were lacking in a practical standard of efficiency. A careful consideration of the situation revealed the fact that the hospitals of the United States and Canada, generally speaking, lacked organization, satisfactory case records, and competent facilities to assist the doctors in carrying on their work. There was not satisfactory co-operation of the profession or the various groups working in the institution. Consultations were few and records incomplete. Any analysis or check-up of the work was lacking in most instances. Owing to these deficiencies candidates who were endeavoring to comply with the requirements for Fellowship in the College found it difficult, if not impossible, to provide satisfactory records of their cases. The College proceeded to gather information along definite lines with regard to the status of hospitals, and soon a large amount of valuable data was accumulated by means of correspondence with hospital officials, boards of trustees, and others, as well as by individual investigation on the part of College representatives. The information secured gave definite evidence of the existing hospital situation in the United States and Canada and was of great value to the College in formulating the program for better surgery.

The information collected was carefully considered and it was realized that there was a definite need for a sound and practical standard embodying certain fundamental principles which would provide the best possible hospital service, both from the standpoint of the patient and the physician. After careful deliberation the minimum standard was formulated—a standard which is minimum in name but maximum in effect, having a universal application and fitting all types of hospitals. This standard provides a fundamental service and procedure which any institution worthy of the name of hospital should accept. It is known as the minimum standard of the American College of Surgeons. This minimum standard is as follows:

THE MINIMUM STANDARD

1. That physicians and surgeons privileged to practice in the hospital be organized as a definite group or staff. Such organization has nothing to do with the question as to whether the hospital is "open" or "closed," nor need it affect the various existing types of staff organization. The word staff is here defined as the group of doctors who practice in the hospital inclusive of all groups such as the "regular staff," the "visiting staff," and the "associate staff."

2. That membership upon the staff be restricted to physicians and surgeons who are (a) competent in their respective fields and (b) worthy in character and in matters of professional ethics; that in this latter connection the practice of the division of fees, under any guise whatever, be prohibited.

3. That the staff initiate and, with the approval of the governing board of the hospital, adopt rules, regulations, and policies governing the professional work of the hospital; that these rules, regulations, and policies specifically provide: (a) That staff meetings be held at least once each month. (In large hospitals the departments may choose to meet separately.) (b) That the staff review and analyze at regular intervals the clinical experience of the staff in the various departments of the hospital, such as medicine, surgery, and obstetrics; the clinical records of patients, free and pay, to be the basis for such review and analysis.

4. That accurate and complete case records be written for all patients and filed in an accessible manner in the hospital, a complete case record being one, except in emergency, which includes the personal history, the physical examination, with clinical, pathological, and X-ray findings when indicated, the working diagnosis, the treatment, medical and surgical, the medical progress, the condition on discharge with final diagnosis, and, in case of death, the autopsy findings when available.

5. That clinical laboratory facilities be available for the study, diagnosis, and treatment of patients, these facilities to include at least chemical, bacteriological, serological, histological, radiographic, and fluoroscopic service in charge of trained technicians.

THE PRESENTATION OF THE PROGRAM OF HOSPITAL STANDARDIZATION TO THE HOSPITALS

Through the medium of the hospital visitor, hospital conferences held in various parts of the United States and Canada and widespread correspondence, the foundation of hospital standardization has been laid and the superstructure is now being well developed. The program of the American College of Surgeons is presented annually to all general hospitals of fifty beds and over in the United States and Canada. This is not done by correspondence but by personal visits of carefully selected investigators. These men are sent out from headquarters to visit the hospital by appointment and carefully survey the institution. They report their findings according to a definite and prescribed form laid down by the College. When possible they meet the various groups in conference, explaining the workings of the program and discussing such matters as pertain to the improvement of the service. The visitor reports to headquarters and a follow-up is maintained. The procedure, therefore, is to analyze through personal investigation the general hospitals of 50 beds and over in the United States and Canada, in terms of the minimum standard of service.

WHAT THE MINIMUM STANDARD REQUIRES

The minimum standard of the American College of Surgeons presents the following principles as essential to its attainment.

1. The doctors practicing in the hospital shall be organized as a staff. This organization may be carried out in either an "open" or a "closed" hospital. The staff should elect from time to time a chairman and secretary. Much of the success of the staff organization and staff meetings is dependent upon the efficiency of these two officers who must exercise good leadership and initiative.

2. The medical staff of the hospital shall be competent and ethical. The American College of Surgeons is absolutely opposed to the practice of "fee-splitting" in any manner whatsoever, and it is required that the staff of every hospital accepted under the minimum standard shall take a very definite stand in this regard.

3. The medical staff shall draw up rules and regulations for the guidance of the professional work in the hospital. By means of such rules and regulations the medical work of the institution is co-ordinated and systematized.

4. The medical staff shall hold conferences periodically, at least once every month, for analysis and review of the work carried on in the institution. At these conferences there should be a careful review of the medical work during the intervening period. It is advisable that a definite agenda be prepared for each meeting. This agenda should include consideration of the following: (a) the patients now resident in the hospital; (b) the patients discharged since the last staff meeting and the results of their treatment with special reference to the unimproved, infected, or complicated, and the deaths; and (c) everything pertaining to the betterment of the hospital service.

All discussion or criticisms at staff meetings should be of a constructive nature. A record of the proceedings should be kept by the secretary. The monthly analysis sheet has been found to be of great value in the staff conference.

5. There shall be a complete medical case record of every patient passing through the institution. There are certain fundamental requirements for a good case record system in any hospital. There is, first of all, the realization that the case record is a necessary part of the care and treatment of the patient. There must be the facilities for securing and filing of such records. The component parts should be carefully assembled and when complete form a comprehensive document setting forth the following information: identification data, complaints, personal and family history, history of the present illness, physical examination, consultations and special examinations, pre-operative or pre-treatment diagnosis, operation or treatment, final diagnosis, progress notes, condition on discharge and follow-up. Every record should be a comprehensive word picture of the patient, the illness, and other essential data. It should be an honest, sincere

record of facts and conclusions; otherwise it is of little value.

The securing and supervising of records is the responsibility of the physician. The filing of records is usually placed in the hands of a competent clerk. Various systems are utilized in hospitals. Whatever system is used these records should be readily accessible when required in the interest of the patient or the physician.

6. The hospital shall have an efficient laboratory and X-ray service. Both of these departments are absolutely essential for the carrying out of up-to-date diagnosis and treatment. They should be under the control of competent directors who may have technicians as their assistants. Unreliable laboratory or X-ray service is a serious detriment to any hospital and is decidedly dangerous. For the benefit of the surgical service and to promote good team work between the surgeon, the pathologist, and radiologist, it is advisable that these departments should be within easy access of the operating rooms. There are certain routine and fundamental tests or examinations which every laboratory and X-ray department should be equipped to carry on, and which may be immediately necessary at any time in any hospital. In standardized hospitals, routine pathological examination of all tissues is required in order that there may be a proper check-up on the work.

PROGRESS AND DEVELOPMENT OF THE MOVEMENT

During the past six years, hospitals of 100 beds and over in the United States and Canada have been carefully reviewed. Each year a list of hospitals meeting the minimum standard requirements is published and officially announced at the Clinical Congress of the American College of Surgeons. In addition, during the past two years, hospitals of 50 to 100 beds have been surveyed and those meeting the standard have also been added to the approved list. The progress and development of the movement today is well shown by the following figures taken from the list of approved hospitals between the years 1918 and 1923 inclusive.

Year	Hospitals Surveyed	Hospitals Approved	Percentage
	100 Beds and Over		
1918	692	89	12.9
1919	692	198	28.6
1920	692	407	58.8
1921	761	573	75.3
1922	812	677	83.4
1923	870	749	86.1
	50 to 100 Beds		
1922	812	335	41.3
1923	916	427	46.7

During 1923, 1786 hospitals were surveyed in the United States and Canada. Of these 1176, or 65.9 per cent, were approved as meeting the minimum standard.

These figures show conclusively that the medical, the hospital profession, and the public are profoundly interested in the program of hospital betterment. Without the support and co-operation of the above groups, the movement could not have succeeded.

REACTIONS TO HOSPITAL STANDARDIZATION

The hospital standardization movement, though still in its youth, has reached maturity in influence and development. It may justly be regarded as one of the greatest hospital movements known in history. The figures quoted show its magnitude and the enormous work associated with its development.

Four results of importance may be claimed for this program: (1) the shortening of the patient's days' stay in the hospital; (2) the preventing of any incompetent or unnecessary surgery; (3) the minimizing of the number of infections and complications; and (4) the lowering of the hospital death rate. In regard to the latter, it is very interesting to find that the average hospital death rate, which has been generally from 30, 40, and, in some instances, 50 per thousand patients treated, has been declining in certain institutions which have been operating strictly under the principles laid down by hospital standardization. Many instances show a falling of the death rate down to 30, 20, and even less per thousand patients.

These results have been accomplished through the sincere, honest, conscientious application of the principles as laid down by the College in the program for better hospitals. What a great thing it will be to industry if the days' stay of each industrial patient can be reduced 1 or 2 days in each illness. What a great comfort it will be to our people to know that they can go into certain hospitals where their illnesses will be more thoroughly studied and all data recorded, and through this an operation avoided or done under conditions surrounded with the maximum efficiency and safety. What a great thing to the world to find that the former average death rate per thousand patients can be reduced to 30, 20, or lower.

Possibly the greatest accomplishment to stimulate better results is the realization that there must be a physical accounting in our hospitals each month. Each institution should produce a physical balance sheet for the same reasons as there is a financial balance sheet. Both of these statements must be duly audited, the former by

NUMBER OF HOSPITALS MEETING THE MINIMUM STANDARD

United States and Canada	100 or more Beds			50 to 100 Beds			All Hospitals over 50 Beds		
	Number of Hospitals	Approved		Number of Hospitals	Approved		Number of Hospitals	Approved	
		Number	Percentage		Number	Percentage		Number	Percentage
Alabama	10	9	90	14	4	28.6	24	13	54.2
Arizona	2	1	50	2	0	....	4	1	25
Arkansas	5	4	80	10	9	90	15	13	86.7
California	47	34	72.3	29	6	20.7	76	40	52.6
Colorado	13	11	84.6	4	2	50	17	13	76.5
Connecticut	15	14	93.3	8	2	25	23	16	69.6
Delaware	2	2	100	1	0	....	3	2	66.7
District of Columbia	11	9	81.8	2	0	....	13	9	69.2
Florida	6	3	50	8	2	25	14	5	35.7
Georgia	12	9	75	17	8	47	29	17	58.6
Idaho	1	1	100	7	4	57.1	8	5	64.5
Illinois	62	42	67.7	61	21	34.4	123	63	51.2
Indiana	20	14	70	14	8	57.1	34	22	64.7
Iowa	14	12	85.7	27	15	55.6	41	27	65.9
Kansas	6	6	100	25	18	72	31	24	77.4
Kentucky	8	8	100	14	5	35.7	22	13	59.1
Louisiana	7	7	100	10	6	60	17	13	76.5
Maine	5	4	80	10	5	50	15	9	60
Maryland	15	14	93.3	11	6	54.5	26	20	76.9
Massachusetts	44	41	93.2	37	19	51.4	81	60	74.1
Michigan	25	25	100	20	9	45	45	34	75.6
Minnesota	27	27	100	20	9	45	47	36	76.6
Mississippi	5	3	60	8	2	25	13	5	38.5
Missouri	26	24	92.3	22	13	59.1	48	37	77.1
Montana	5	5	100	11	7	63.6	16	12	75
Nebraska	9	8	88.9	15	5	33	24	13	54.2
Nevada	0	..	....	2	2	100	2	2	100
New Hampshire	1	1	100	11	6	54.5	12	7	58.3
New Jersey	35	31	88.6	11	4	36.4	46	35	76.1
New Mexico	0	..	....	4	2	50	4	2	50
New York	120	105	87.5	72	35	48.6	192	140	72.9
North Carolina	5	4	80	21	11	52.4	26	15	57.6
North Dakota	5	5	100	7	2	28.6	12	7	58.3
Ohio	43	42	97.7	28	20	71.4	71	62	87.3
Oklahoma	2	2	100	12	2	16.7	14	4	28.6
Oregon	4	4	100	14	3	21.4	18	7	38.9
Pennsylvania	86	80	93	80	35	43.8	166	115	69.3
Rhode Island	3	3	100	3	2	66.7	6	5	83.3
South Carolina	5	5	100	11	4	36.4	16	9	56.3
South Dakota	4	3	75	12	10	83.3	16	13	81.3
Tennessee	10	9	90	12	7	58.3	22	16	72.7
Texas	21	16	76.2	22	9	40.9	43	25	58.1
Utah	5	5	100	1	1	100	6	6	100
Vermont	1	1	100	5	4	80	6	5	83.3
Virginia	7	6	85.7	28	12	42.9	35	18	51.4
Washington	16	15	93.8	18	4	22.2	34	19	55.9
West Virginia	6	6	100	23	7	30.4	29	13	44.8
Wisconsin	24	17	70.8	27	13	48.1	51	30	58.8
Wyoming	1	..	....	6	2	33.4	7	2	28.6
Totals for United States	806	697	86.5	837	382	45.6	1643	1079	65.7
Alberta	7	7	100	4	2	50	11	9	81.8
British Columbia	6	6	100	7	4	57.1	13	10	76.2
Manitoba	6	6	100	2	1	50	8	7	87.5
New Brunswick	1	1	100	9	8	88.9	10	9	90
Nova Scotia	3	3	100	8	8	100	11	11	100
Ontario	25	16	64	30	12	40	55	28	50.9
Prince Edward Island	0	..	....	3	3	100	3	3	100
Quebec	11	9	81.8	9	3	33.4	20	12	60
Saskatchewan	5	4	80	7	4	57.1	12	8	66.7
Totals for Canada	64	52	81.3	79	45	57.7	143	97	68.3
Grand Totals	870	749	86.1	916	427	46.7	1786	1176	65.9

the staff or medical auditors, and the second by the financial auditors, or so-called chartered accountants.

The effect of hospital standardization is more or less generally felt throughout the institution. The organization of the medical staff stimulates better organization throughout the hospital. A higher degree of ethics practiced among the attending doctors reacts beneficially on the nursing staff and internes. Through efficiency, accuracy, and thoroughness on the professional side of the institution, a decided influence along similar lines finds expression in the work of all the other groups. This program undoubtedly establishes an all around spirit of co-operation, rapidly embracing the various groups working in the institution. There is disseminated throughout the spirit of helpfulness, one to another, developing an increasing desire for more communalistic effort than formerly. In a hospital, particularly, we must remember that the various groups working therein cannot carry on without very intimate contact. There is in every hospital an ever present interdependence among the various individuals or groups working therein. There must be provision made for interchange and interaction. In order that there be established the best possible correlation of the various activities for the greatest benefit to the patient, there must be a very highly developed spirit of co-operation.

There is an added stimulus of clinical interest resulting in closer investigation of medical problems, and the advancement of scientific research. The regular staff conference is responsible in great measure for this stimulus. The staff conference brings the doctors together in a group, frequently breaking down local jealousies and always promoting a better spirit of working and consulting together.

Anything that tends to improve the professional atmosphere of the hospital cannot help but have a decided advantage and influence throughout. Therefore, we find that the program of hospital standardization today finds expression in a universal effect on the entire institution, establishing a higher ideal of service and producing a more profound professional consciousness, causing the three groups, namely, the governmental body, the doctors, and the hospital staff, all to work together better for the patient.

Outside of the hospital, the movement is a community interest. People today are seeking the standardized hospital when ill, for they know that the service therein is better administered and supervised. The governments, municipal bodies, and philanthropic organizations make use of the list of approved hospitals when responding to requests for financial assistance. Internes select the approved hospital when furthering their experience. Young women, desiring to take up nursing, also give preference to the approved hospital, knowing that such an institution is better organized and more efficient and can give a more thorough training. In certain instances, state and provincial governments have embodied the principles of hospital standardization in the clauses of their acts when formulating hospital legislation. This movement has been endorsed by a large number of allied organizations of the United States and Canada.

THE FUTURE OF HOSPITAL STANDARDIZATION

For a period of six years the minimum standard of the American College of Surgeons has been presented to the hospitals of this continent. The general principles of the movement have been well established, and it is now recognized that the important details and further development of the program may safely be undertaken.

There are in connection with the College several committees actively engaged in the study of certain problems relating not only to the various services in our hospitals but as well to the scientific treatment of certain types of patients. The beneficial results obtained from these investigations will be made available for hospitals and should be of inestimable value to them in their advancement.

From time to time requests for information on various subjects are being made to the College. So numerous have these become of late and such is the desire of the College to assist, that it has been found advisable to establish a bureau of information for hospitals. Through this a more extensive and continuous service can be given from headquarters.

The problem of the standardization of the smaller hospitals under 50 beds is being given careful consideration and its solution will be forthcoming in the near future.

Hospital standardization is but in its youth. It has now been proved to be an indispensable factor in increasing the efficiency of hospitals. This movement backed up by a more detailed service from the hospital department of the College will go on from year to year to a much greater attainment even than that which has been established at the present time. The future will, therefore, see a further development of the program and an increased interest and appreciation of the work as all groups directly or indirectly connected with the hospital service are fully convinced of its

value to the patient, the doctor, the hospital, and the entire community.

THE 1923 SURVEY

A complete list of approved hospitals from the 1923 survey follows. The work has increased considerably during the year, the magnitude of which can only be realized from the following considerations. There were nine hospital visitors engaged in the field who did sixty months (or five years) of survey work in 1923. The 1786 hospitals visited contained 237,946 beds caring for approximately 4,758,920 patients during the year. The estimated days' treatment for this group is 71,383,800. In the 1176 hospitals which have been accepted as approved there are 191,042 beds caring for approximately 3,820,840 patients with an estimated days' treatment of 57,312,600 for the year. During the survey work the visitors traveled approximately 75,000 miles. Follow-up letters from headquarters numbered over 3500. In addition to all this, 34 sectional meetings of the Clinical Congress of the American College of Surgeons were held in various parts of the United States and Canada. At each meeting, an interesting two-day program was provided. A considerable portion of this program on each occasion was devoted to hospital standardization. These meetings throughout were largely attended and fruitful of good results. All the above indicates the opportunity the hospital standardization movement has for extending its beneficial influence.

LIST OF HOSPITALS

The list which follows is complete up to October 22d of this year. The asterisk indicates that certain hospitals have accepted the requirements which result in the best scientific care of the patients but have not yet, for lack of time or other acceptable reasons, carried them out in every detail.

UNITED STATES

ALABAMA

100 or more beds

*Birmingham Baptist Hospital, Birmingham
Employees' Hospital, T. C. I. R. R. Co., Birmingham
Hillman Hospital, Birmingham
Mobile City Hospital, Mobile
*Moody Hospital, Dotham
Norwood Hospital, Birmingham
Providence Infirmary, Mobile
St. Vincent's Hospital, Birmingham
South Highlands Infirmary, Birmingham

50 to 100 beds

*Alabama Baptist Hospital, Selma
*Frasier Hospital, Dotham
John A. Andrew Memorial Hospital, Tuskegee
Vaughan Memorial Hospital, Selma

ARIZONA

100 or more beds

St. Joseph's Hospital, Phoenix

ARKANSAS

100 or more beds

Logan H. Roots City Memorial Hospital, Little Rock
St. Louis Southwestern R. R. Hospital, Texarkana
St. Vincent's Infirmary, Little Rock
Sparks Memorial Hospital, Fort Smith

50 to 100 beds

Baptist Hospital, Little Rock
*Davis Hospital, Pine Bluff
*Fayetteville City Hospital, Fayetteville
Leo N. Levi Memorial Hospital, Hot Springs
Michael Meager Memorial Hospital, Texarkana
St. Bernard's Hospital, Jonesboro
*St. John's Hospital, Fort Smith
*St. Joseph's Hospital, Hot Springs
St. Luke's Hospital and Annex, Little Rock

CALIFORNIA

100 or more beds

Alameda County Hospital, San Leandro
California Lutheran Hospital, Los Angeles
Children's Hospital, Los Angeles
*French Hospital, San Francisco
General Hospital, Fresno
Golden State Hospital, Los Angeles
Hospital for Children, San Francisco
Hospital of the Good Samaritan, Los Angeles
Loma Linda Sanitarium and Hospital, Loma Linda
Los Angeles General Hospital, Los Angeles
Mary's Help Hospital, San Francisco
Methodist Hospital, Los Angeles
Mt. Zion Hospital, San Francisco
*O'Connor Sanitarium, San Jose
Pasadena Hospital, Pasadena
Providence Hospital, Oakland
Sacramento Hospital, Sacramento
*St. Francis' Hospital, San Francisco
*St. Helen Sanitarium, Sanitarium
*St. Joseph's Hospital, San Francisco
St. Joseph's Hospital, San Diego
St. Mary's Hospital, San Francisco
St. Vincent's Hospital, Los Angeles
Samuel Merritt Hospital, Oakland
*San Diego County Hospital, San Diego
San Francisco Hospital, San Francisco
San Joaquin General Hospital, French Camp
Santa Barbara Cottage Hospital, Santa Barbara
Santa Clara County Hospital, San Jose
Seaside Hospital, Long Beach
Southern Pacific Hospital, San Francisco
Stanford University and Lane Hospitals, San Francisco
University of California Hospital, San Francisco
White Memorial Hospital, Los Angeles

50 to 100 beds

Clara Barton Hospital, Los Angeles
Mercy Hospital, Bakersfield
Murphy Memorial Hospital, Whittier
Orthopaedic Hospital, Los Angeles
*Paradise Valley Hospital, National City
*Ramona Hospital, San Bernardino

COLORADO

100 or more beds

Beth-El Hospital, Colorado Springs
*Boulder-Colorado Sanitarium, Boulder
Children's Hospital, Denver
Glockner General Hospital, Colorado Springs
Mercy Hospital, Denver
Minnequa Hospital, Pueblo
St. Anthony's Hospital, Denver
St. Francis' Hospital, Colorado Springs
St. Joseph's Hospital, Denver
St. Luke's Hospital, Denver
St. Mary's Hospital, Pueblo

50 to 100 beds

*Denver and Rio Grande Western R. R. Hospital, Salida
*Red Cross Hospital, Salida

CONNECTICUT

100 or more beds

Bridgeport Hospital, Bridgeport
Grace Hospital, New Haven
Greenwich General Hospital, Greenwich
Hartford Hospital, Hartford
*Hospital of St. Raphael, New Haven
Lawrence and Memorial Associated Hospitals, New London
*Meriden Hospital, Meriden
*Middlesex Hospital, Middletown
New Haven Hospital, New Haven
St. Francis' Hospital, Hartford
St. Mary's Hospital, Waterbury
St. Vincent's Hospital, Bridgeport
*Stamford Hospital, Stamford
Waterbury Hospital, Waterbury

50 to 100 beds

New Britain Hospital, New Britain
*Norwalk Hospital, Norwalk

DELAWARE

100 or more beds

*Delaware Hospital, Wilmington
*Homeopathic Hospital, Wilmington

DISTRICT OF COLUMBIA

100 or more beds

*Central Hospital and Dispensary, Washington
*Children's Hospital, Washington
Columbia Hospital for Women, Washington
Freedman's Hospital, Washington
Garfield Memorial Hospital, Washington
George Washington University Hospital, Washington
Georgetown University Hospital, Washington
Providence Hospital, Washington
*Washington Sanitarium and Hospital, Washington

FLORIDA

100 or more beds

Duval County Hospital, Jacksonville
*Miami City Hospital, Miami
St. Luke's Hospital, Jacksonville

50 to 100 beds

*Faith Hospital, St. Petersburg
Gordon Keller Memorial Hospital, Tampa

GEORGIA

100 or more beds

*Davis-Fischer Hospital, Atlanta
Georgia Baptist Hospital, Atlanta
Grady Memorial Hospital, Atlanta
Harbin Hospital, Rome
Piedmont Sanitarium, Atlanta
*St. Joseph's Hospital, Savannah
St. Joseph's Infirmary, Atlanta
University Hospital, Augusta
Wesley Memorial Hospital, Atlanta

50 to 100 beds

*Atlantic Coast Line Hospital, Waycross
*Downey Hospital, Gainesville
*Park View Sanitarium, Savannah
*Savannah Hospital, Savannah
Scottish Rite Hospital, Decatur
*Telfair Hospital, Savannah
*Thomasville City Hospital, Thomasville
Wise Sanitarium, Plains

IDAHO

100 or more beds

St. Alphonsus Hospital, Boise

50 to 100 beds

Pocatello General Hospital, Pocatello
*Providence Hospital, Wallace
*St. Anthony's Hospital, Pocatello
St. Luke's Hospital, Boise

ILLINOIS

100 or more beds

*Alexian Brothers' Hospital, Chicago
Augustana Hospital, Chicago
Chicago Lying-in Hospital, Chicago
Chicago Memorial Hospital, Chicago
Children's Memorial Hospital, Chicago
Columbus Hospital, Chicago
Cook County Hospital, Chicago
Evanston Hospital, Evanston
*Frances E. Willard Hospital, Chicago
*Grant Hospital, Chicago
*Hinsdale Sanitarium, Hinsdale
Hospital of St. Anthony de Padua, Chicago
Illinois Central Hospital, Chicago
Illinois Charitable Eye and Ear Infirmary, Chicago
*Lake View Hospital, Danville
Lutheran Deaconess Hospital, Chicago
*Lutheran Memorial Hospital, Chicago
Mercy Hospital, Chicago
Michael Reese Hospital, Chicago
Misericordia Hospital, Chicago
Mt. Sinai Hospital, Chicago

*Oak Park Hospital, Oak Park
Presbyterian Hospital, Chicago
Rockford Hospital, Rockford
St. Anne's Hospital, Chicago
St. Bernard's Hospital, Chicago
St. Elizabeth's Hospital, Chicago
*St. Elizabeth's Hospital, Danville
St. Francis' Hospital, Blue Island
St. Francis' Hospital, Evanston
St. Francis' Hospital, Peoria
St. Joseph's Hospital, Chicago
*St. Joseph's Hospital, Joliet
St. Luke's Hospital, Chicago
St. Mary's Hospital, East St. Louis
St. Mary's Infirmary, Cairo
*St. Mary's Hospital, Quincy
St. Mary of Nazareth Hospital, Chicago
South Shore Hospital, Chicago
Swedish Covenant Hospital, Chicago
University Hospital, Chicago
Wesley Memorial Hospital, Chicago

50 to 100 beds

*Blessing Hospital, Quincy
*Garfield Park Hospital, Chicago
Huber Memorial Hospital, Pana
Illinois Masonic Hospital, Chicago
*Kewanee Public Hospital, Kewanee
*Lake View Hospital, Chicago
*Lutheran Hospital, Moline
*Moline Public Hospital, Moline
North Chicago Hospital, Chicago
*Olney Sanitarium, Olney
Our Savior's Hospital, Jacksonville
Passavant Memorial Hospital, Jacksonville
*Post-Graduate Hospital, Chicago
*Provident Hospital, Chicago
Ravenswood Hospital, Chicago
St. Andrew's Hospital, Murphysboro
*St. Elizabeth's Hospital, Granite City
*St. Francis' Hospital, Freeport
*St. Francis' Hospital, Kewanee
St. Mary's Hospital, LaSalle
Washington Boulevard Hospital, Chicago

INDIANA

100 or more beds

Ft. Wayne Lutheran Hospital, Ft. Wayne
Gary Hospital, Gary
Indianapolis City Hospital, Indianapolis
*Methodist Episcopal Hospital, Indianapolis
*Protestant Deaconess Hospital, Evansville
Robert W. Long Hospital, Indianapolis
St. Anthony's Hospital, Terre Haute
*St. Edward's Hospital, New Albany
St. Elizabeth's Hospital, LaFayette
St. Joseph's Hospital, Ft. Wayne
St. Margaret's Hospital, Hammond
St. Mary's Hospital, Evansville
St. Mary's Mercy Hospital, Gary
*St. Vincent's Hospital, Indianapolis

50 to 100 beds

Epworth Hospital, South Bend
*Grant County Hospital, Marion
Muncie Home Hospital, Muncie
LaFayette Home and Hospital, LaFayette
Reid Memorial Hospital, Richmond
*St. Joseph's Hospital, Logansport
St. Joseph's Hospital, South Bend
Walker Hospital, Evansville

IOWA

100 or more beds

Finley Hospital, Dubuque
Iowa Lutheran Hospital, Des Moines
Iowa Methodist Hospital, Des Moines
Jennie Edmundson Hospital, Council Bluffs
Mercy Hospital, Cedar Rapids
Mercy Hospital, Council Bluffs
Mercy Hospital, Davenport
*Mercy Hospital, Des Moines
St. Joseph's Mercy Hospital, Dubuque
St. Joseph's Mercy Hospital, Sioux City
St. Vincent's Hospital, Sioux City
University Hospital, Iowa City

50 to 100 beds

*Des Moines City Hospital, Des Moines
Iowa Congregational Hospital, Des Moines
Iowa State College Hospital, Ames
Jane Lamb Memorial Hospital, Clinton
Lutheran Hospital, Hampton
Lutheran Hospital, Sioux City
New Samaritan Hospital, Sioux City
*Ottumwa Hospital, Ottumwa
Park Hospital, Mason City
St. Francis' Hospital, Waterloo
*St. Joseph's Hospital, Keokuk
St. Joseph's Hospital, Waverly
St. Joseph's Mercy Hospital, Clinton
St. Joseph's Mercy Hospital, Fort Dodge
St. Joseph's Mercy Hospital, Mason City

KANSAS

100 or more beds

Bethany Methodist Hospital, Kansas City
St. Francis' Hospital, Wichita
St. Margaret's Hospital, Kansas City
Santa Fe Hospital, Topeka
*Wesley Hospital, Wichita
*Wichita Hospital, Wichita

50 to 100 beds

Axtell Hospital, Newton
Bell Memorial Hospital, Kansas City
Bethel Deaconess Hospital, Newton
Halstead Hospital, Halstead
Hutchinson Methodist Hospital, Hutchinson
Jane C. Stormont Hospital, Topeka
*Mercy Hospital, Fort Scott
*Missouri, Kansas, and Texas R. R. Hospital, Parsons
*Mt. Carmel Hospital, Pittsburg
Providence Hospital, Kansas City
St. Anthony's Hospital, Hays
St. Anthony's Mercy Hospital, Sabetha
St. Elizabeth's Hospital, Hutchinson
St. Francis' Hospital, Topeka
St. John's Hospital, Salina
*St. Joseph's Hospital, Concordia
*St. Mary's Hospital, Winfield
St. Rose's Hospital, Great Bend

KENTUCKY

100 or more beds

Good Samaritan Hospital, Lexington
Louisville City Hospital, Louisville

Norton Memorial Hospital, Louisville
St. Anthony's Hospital, Louisville
*St. Elizabeth's Hospital, Covington
Sts. Elizabeth and Mary Hospital, Louisville
St. Joseph's Hospital, Lexington
St. Joseph's Infirmary, Louisville

50 to 100 beds

*Booth Memorial Hospital, Covington
Deaconess Hospital, Louisville
Illinois Central Hospital, Paducah
*Jewish Hospital, Louisville
*Wm. Mason Memorial Hospital, Murray

LOUISIANA

100 or more beds

Charity Hospital, New Orleans
*Charity Hospital, Shreveport
Hotel Dieu, New Orleans
*Presbyterian Hospital, New Orleans
St. Francis' Sanitarium, Munroe
T. E. Schumpert Memorial Hospital, Shreveport
Touro Infirmary, New Orleans

50 to 100 beds

Eye, Ear, Nose and Throat Hospital, New Orleans
*Flint-Goodridge Hospital, New Orleans
Illinois Central R. R. Hospital, New Orleans
North Louisiana Sanitarium, Shreveport
St. Patrick's Sanitarium, Lake Charles
Shriners' Hospital for Crippled Children, Shreveport

MAINE

100 or more beds

*Central Maine General Hospital, Lewiston
General Hospital of St. Marie, Lewiston
Eastern Maine General Hospital, Bangor
*Maine General Hospital, Portland

50 to 100 beds

*Augusta General Hospital, Augusta
Bath City Hospital, Bath
Children's Hospital, Portland
St. Barnabas Hospital, Portland
*State Street Hospital, Portland

MARYLAND

100 or more beds

Allegany Hospital, Cumberland
Bay View City Hospital, Baltimore
Church Home and Infirmary, Baltimore
Colonial Hospital, Baltimore
*Franklin Square Hospital, Baltimore
Hebrew Hospital and Asylum, Baltimore
Hospital for Women of Maryland, Baltimore
Johns Hopkins Hospital, Baltimore
Maryland General Hospital, Baltimore
Mercy Hospital, Baltimore
St. Agnes' Hospital, Baltimore
St. Joseph's Hospital, Baltimore
Union Hospital, Baltimore
University Hospital, Baltimore

50 to 100 beds

Children's Hospital School, Baltimore
Emergency Hospital, Easton
Frederick City Hospital, Frederick
James Lawrence Kerman Hospital, Baltimore
*South Baltimore General Hospital, Baltimore
*Western Maryland Hospital, Cumberland

MASSACHUSETTS

100 or more beds

Beverly Hospital, Beverly
Boston City Hospital, Boston
Brockton Hospital, Brockton
Burbank Hospital, Fitchburg
Cambridge City Hospital, Cambridge
Cambridge Hospital, Cambridge
Carney Hospital, Boston
Children's Hospital, Boston
City Hospital, Fall River
Cooley-Dickinson Hospital, Northampton
Free Hospital for Women, Boston
Gale Hospital, Haverhill
Henry Heywood Memorial Hospital, Gardner
Holyoke City Hospital, Holyoke
House of Mercy Hospital, Pittsfield
Lawrence General Hospital, Lawrence
Long Island Hospital, Boston
Lowell Corporation Hospital, Lowell
Lowell General Hospital, Lowell
Lynn Hospital, Lynn
*Malden Hospital, Malden
Massachusetts Charitable Eye and Ear Hospital, Boston
Massachusetts General Hospital, Boston
Massachusetts Homeopathic Hospital, Boston
Memorial Hospital, Worcester
Mercy Hospital, Springfield
New England Hospital for Women and Children, Boston
Newton Hospital, Newton Lower Falls
Noble Hospital, Westfield
Peter Bent Brigham Hospital, Boston
Providence Hospital, Holyoke
St. Elizabeth's Hospital, Boston
St. John's Hospital, Lowell
St. Luke's Hospital, New Bedford
St. Vincent's Hospital, Worcester
Salem Hospital, Salem
Springfield Hospital, Springfield
Union Hospital, Fall River
Waltham Hospital, Waltham
Wesson Memorial Hospital, Springfield
Worcester City Hospital, Worcester

50 to 100 beds

Beth Israel Hospital, Boston
Boston Lying-in Hospital, Boston
Charles Choate Memorial Hospital, Woburn
*Chelsea Memorial Hospital, Chelsea
City Hospital, Quincy
Clinton Hospital, Clinton
Farren Memorial Hospital, Montague City
Faulkner Hospital, Boston
Goddard Hospital, Brockton
Hart Private Hospital, Roxbury
House of the Good Samaritan, Boston
Infant's Hospital, Boston
*Josiah B. Thomas Hospital, Peabody
Melrose Hospital, Melrose
Morton Hospital, Taunton
North Adams Hospital, North Adams
Somerville Hospital, Somerville
Sturdy Memorial Hospital, Attleboro
Truesdale Hospital, Fall River

MICHIGAN

100 or more beds

Battle Creek Sanitarium, Battle Creek
Blodgett Memorial Hospital, Grand Rapids
Butterworth Hospital, Grand Rapids
Children's Free Hospital, Detroit
Detroit Receiving Hospital, Detroit
Evangelical Deaconess Hospital, Detroit
Grace Hospital, Detroit
Edward W. Sparrow Hospital, Lansing
Hackley Hospital, Muskegon
Harper Hospital, Detroit
Henry Ford Hospital, Detroit
Highland Park General Hospital, Highland Park
House of Providence, Detroit
*Hurley Hospital, Flint
Mercy Hospital, Bay City
*Mercy Hospital, Muskegon
New Borgess Hospital, Kalamazoo
Old Borgess Hospital, Kalamazoo
St. Joseph's Mercy Hospital, Ann Arbor
St. Mary's Hospital, Detroit
St. Mary's Hospital, Grand Rapids
*Saginaw General Hospital, Saginaw
University Hospital, Ann Arbor
W. A. Foote Memorial Hospital, Jackson
Woman's Hospital and Infants' Home, Detroit

50 to 100 beds

Bronson Methodist Hospital, Kalamazoo
Detroit Eye and Ear Hospital, Detroit
Memorial Hospital, Owosso
Mercy Hospital, Jackson
*Nichols Memorial Hospital, Battle Creek
*St. Francis' Hospital, Escanaba
St. Joseph's Hospital, Detroit
St. Joseph's Hospital, Hancock
St. Mary's Hospital, Saginaw

MINNESOTA

100 or more beds

*Abbott Hospital, Minneapolis
Ancker Hospital, St. Paul
Bethesda Hospital, St. Paul
Charles T. Miller Hospital, St. Paul
Colonial Hospital, Rochester
Deaconess Hospital, Minneapolis
Eitel Hospital, Minneapolis
Fairview Hospital, Minneapolis
Kahler Hospital, Rochester
Maternity Hospital, Minneapolis
Minneapolis General Hospital, Minneapolis
Minnesota State Hospital for Indigent Children, Minneapolis
Mounds Park Sanitarium, St. Paul
Northern Pacific Beneficial Association Hospital, St. Paul
Northwestern Hospital, Minneapolis
St. Barnabas Hospital, Minneapolis
St. John's Hospital, St. Paul
St. Joseph's Hospital, St. Paul
St. Luke's Hospital, Duluth
St. Luke's Hospital, St. Paul
St. Mary's Hospital, Minneapolis
St. Mary's Hospital, Duluth
St. Mary's Hospital, Rochester
St. Paul Hospital, St. Paul
Swedish Hospital, Minneapolis
University of Minnesota Hospital, Minneapolis
Worrell Hospital, Rochester

50 to 100 beds

Hill Crest Surgical Hospital, Minneapolis
*Immanuel Hospital, Mankato
*St. Gabriel's Hospital, Little Falls
*St. Joseph's Hospital, Brainerd
*St. Joseph's Hospital, Mankato
*St. Luke's Hospital, Fergus Falls
St. Raphael's Hospital, St. Cloud
Shriners' Hospital for Crippled Children, Minneapolis
*Warren General Hospital, Warren

MISSISSIPPI

100 or more beds

East Mississippi Charity Hospital, Meridian
*Mississippi State Charity Hospital, Jackson
South Mississippi Charity Hospital, Laurel

50 to 100 beds

King's Daughters' Hospital, Gulfport
Mississippi Baptist Hospital, Jackson

MISSOURI

100 or more beds

Alexian Brothers' Hospital, St. Louis
Barnes Hospital, St. Louis
Children's Mercy Hospital, Kansas City
Christian Church Hospital, Kansas City
Evangelical Deaconess Home and Hospital, St. Louis
Frisco Employees Hospital, St. Louis
*Grace Hospital, Kansas City
Jewish Hospital, St. Louis
Kansas City General Hospital, Kansas City
Lutheran Hospital, St. Louis
Missouri Baptist Sanitarium, St. Louis
Missouri Pacific R. R. Hospital, St. Louis
Old General Hospital, Kansas City
Research Hospital, Kansas City
St. Anthony's Hospital, St. Louis
St. John's Hospital, St. Louis
St. Joseph's Hospital, Kansas City
St. Louis Children's Hospital, St. Louis
St. Louis City Hospital, St. Louis
St. Louis Mullanphy Hospital, St. Louis
St. Luke's Hospital, Kansas City
St. Luke's Hospital, St. Louis
St. Mary's Hospital, Kansas City
St. Mary's Infirmary, St. Louis

50 to 100 beds

Baptist Hospital, St. Louis
Barnard Free Skin and Cancer Hospital, St. Louis
Bethesda Hospital, St. Louis
*Boone County Hospital, Columbus
Frisco Employees Hospital, Springfield
Independence Sanitarium, Independence
*Parker Memorial Hospital, Columbia
St. Francis' Hospital, Cape Girardeau
St. Francis' Hospital, Maryville
St. John's Hospital, Joplin
St. Mary's Hospital, Jefferson City
Trinity Lutheran Hospital, Kansas City
University Hospital, Kansas City

MONTANA

100 or more beds

Columbus Hospital, Great Falls
*Holy Rosary Hospital, Miles City

Montana Deaconess Hospital, Great Falls
Murray Hospital, Butte
St. James Hospital, Butte

50 to 100 beds

*Bozeman Deaconess Hospital, Bozeman
*Northern Pacific Beneficial Association Hospital, Glendive
Northern Pacific Beneficial Association Hospital, Missoula
St. Ann's Hospital, Anaconda
St. Joseph's Hospital, Lewiston
St. Patrick's Hospital, Missoula
St. Vincent's Hospital, Billings

NEBRASKA

100 or more beds

Bishop Clarkson Memorial Hospital, Omaha
Nebraska Methodist Episcopal Hospital and Deaconess Home, Omaha
*Nebraska Orthopedic Hospital and Home, Lincoln
St. Elizabeth's Hospital, Lincoln
St. Francis' Hospital, Grand Island
St. Joseph's Hospital, Omaha
St. Mary's Hospital, Columbus
University of Nebraska Hospital, Omaha

50 to 100 beds

Immanuel Hospital, Omaha
*Lincoln Hospital, Lincoln
*Presbyterian Hospital, Omaha
Swedish Mission Hospital, Omaha
Wise Memorial Hospital, Omaha

NEVADA

50 to 100 beds

Elko General Hospital, Elko
St. Mary's Hospital, Reno

NEW HAMPSHIRE

100 or more beds

St. Joseph's Hospital, Nashua

50 to 100 beds

Elliott Community Hospital, Keene
Elliott Hospital, Manchester
Hospital of Notre Dame, Manchester
Mary Hitchcock Memorial Hospital, Hanover
Nashua Memorial Hospital, Nashua
Sacred Heart Hospital, Manchester

NEW JERSEY

100 or more beds

Alexian Brothers' Hospital, Elizabeth
*Atlantic City Hospital, Atlantic City
Bayonne Hospital and Dispensary, Bayonne
Christ Hospital, Jersey City
*Cooper Hospital, Camden
Elizabeth General Hospital, Elizabeth
Engelwood Hospital, Engelwood
Hackensack Hospital, Hackensack
Hospital of St. Barnabas, Newark
Jersey City Hospital, Jersey City
*Mercer Hospital, Trenton
Monmouth Memorial Hospital, Long Branch
Morristown Memorial Hospital, Morristown
Mountainside Hospital, Montclair
Muhlenberg Hospital, Plainfield
Newark Beth Israel Hospital, Newark
Newark City Hospital, Newark
Newark Memorial Hospital, Newark
Orange Memorial Hospital, Newark
Passaic General Hospital, Passaic
Paterson General Hospital, Paterson
Perth Amboy City Hospital, Perth Amboy
*Presbyterian Hospital, Newark
St. Elizabeth's Hospital, Elizabeth
St. Francis' Hospital, Jersey City
St. Francis' Hospital, Trenton
St. James' Hospital, Newark
*St. Joseph's Hospital, Paterson
*St. Mary's Hospital, Hoboken
*St. Michael's Hospital, Newark
St. Peter's General Hospital, New Brunswick

50 to 100 beds

Ann May Memorial Hospital, Spring Lake
Homeopathic Hospital, Newark
*Middlesex General Hospital, New Brunswick
Nathan and Mariam Barnert Memorial Hospital, Paterson

NEW MEXICO

50 to 100 beds

*St. Joseph's Hospital, Albuquerque
*St. Mary's Hospital, Gallup

NEW YORK

100 or more beds

Albany Hospital, Albany
*Arnot-Ogden Memorial Hospital, Elmira
Auburn City Hospital, Auburn
Bellevue Hospital, New York
*Beth David Hospital, New York
Beth Israel Hospital, New York
Beth Moses Hospital, Brooklyn
Binghamton Hospital, Binghamton
Broad Street Hospital, New York
*Bronx Hospital, New York
Brooklyn Hospital, Brooklyn
Brownsville and East New York Hospital, Brooklyn
Buffalo City Hospital, Buffalo
Buffalo General Hospital, Buffalo
Buffalo Homeopathic Hospital, Buffalo
Buffalo Hospital of Sisters of Charity, Buffalo
Bushwick Hospital, Brooklyn
Carson C. Peck Memorial Hospital, Brooklyn
Children's Hospital, Buffalo
Columbus Extension Hospital, New York
Community Hospital, New York
Coney Island Hospital, Brooklyn
Cumberland Street Hospital, Brooklyn
Deaconess Home and Hospital, Buffalo
Ellis Hospital, Schenectady
Faxton Hospital, Utica
Fifth Avenue Hospital, New York
Flower Hospital, New York
Flushing Hospital and Dispensary, Flushing
Fordham Hospital, New York
French Benevolent Society Hospital, New York
Gouverneur Hospital, New York
Greenpoint Hospital, Brooklyn
Harlem Hospital, New York
Highland Hospital, Rochester
Holy Family Hospital, Brooklyn

Homeopathic Hospital, Albany
House of the Good Samaritan, Watertown
Hospital of the Good Shepherd, Syracuse
*Ithaca City Hospital, Ithaca
Jewish Hospital, Brooklyn
King's County Hospital, Brooklyn
Knickerbocker Hospital, New York
Lebanon Hospital, New York
Lenox Hill Hospital, New York
Lincoln Hospital, New York
Long Island College Hospital, Brooklyn
Manhattan Eye and Ear Hospital, New York
Memorial Hospital for Cancer and Allied Diseases, New York
Methodist Episcopal Hospital, Brooklyn
Metropolitan Hospital, New York
Misericordia Hospital, New York
Montefiore Hospital, New York
Mt. Sinai Hospital, New York
Mt. St. Mary's Hospital, Niagara Falls
Mt. Vernon Hospital, Mt. Vernon
New York City Hospital, Blackwell's Island, New York
*New York Eye and Ear Infirmary, New York
New York Foundling Home, New York
New York Hospital, New York
New York Infirmary for Women and Children, New York
New York Nursery and Children's Hospital, New York
New York Orthopedic Hospital, New York
New York Post-Graduate Hospital, New York
*New York Skin and Cancer Hospital, New York
New York Society for Relief of the Ruptured and Crippled, New York
*New York State Orthopedic Hospital for Children, West Haverstraw
Niagara Falls Memorial Hospital, Niagara Falls
Norwegian Lutheran Deaconess Hospital, Brooklyn
*Olean General Hospital, Olean
Oneida County Hospital, Rome
Park Avenue Clinical Hospital, Rochester
Presbyterian Hospital, New York
*Prospect Heights Hospital and Maternity, Brooklyn
Rochester General Hospital, Rochester
Rochester Homeopathic Hospital, Rochester
Roosevelt Hospital, New York
St. Catherine's Hospital, Brooklyn
*St. Elizabeth's Hospital and Home, Utica
St. Francis' Hospital, New York
St. John's Brooklyn Hospital, Brooklyn
St. John's Hospital, Long Island
St. John's Riverside Hospital, Yonkers
*St. Joseph's Hospital, Syracuse
St. Luke's Hospital, New York
*St. Luke's Hospital, Utica
St. Mark's Hospital, New York
St. Mary's Free Hospital for Children, New York
St. Mary's Hospital, Brooklyn
St. Mary's Hospital, Rochester
St. Peter's Hospital, Albany
St. Peter's Hospital, Brooklyn
St. Vincent's Hospital, New York
Samaritan Hospital, Troy
Sloane Hospital for Women, New York
*Soldiers and Sailors Memorial Hospital, Utica
Staten Island Hospital, Tompkinsville
Syracuse Memorial Hospital, Syracuse
The Sanitarium, Clifton Springs
Troy Hospital, Troy
*United Hospital, Port Chester
*United Israel Zion Hospital, Brooklyn
Women's Hospital, New York
Wyckoff Heights Hospital, Brooklyn
Yonker's Homeopathic Hospital and Maternity, Yonkers

50 to 100 beds

Amsterdam City Hospital, Amsterdam
Anthony Brady Hospital, Albany
Babies Hospital, New York
*Beekman Street Hospital, New York
*Broad Street Hospital, Oneida
*Brooks Memorial Hospital, Dunkirk
*Buffalo Columbus Hospital, Buffalo
*Champlain Valley Hospital, Plattsburg
Columbus Hospital, New York
Emergency Hospital of Sisters of Charity, Buffalo
General Hospital, Syracuse
Geneva City Hospital, Geneva
Glens Falls Hospital, Glens Falls
*Harbor Hospital, Brooklyn
Hudson City Hospital, Hudson
Jamaica Hospital, Jamaica
Jewish Maternity Hospital, New York
Kingston City Hospital, Kingston
Lawrence Hospital, Bronxville
*Leonard Hospital, Troy
Mary Immaculate Hospital, Jamaica
Mary McClelland Hospital, Cambridge
*Nassau Hospital, Mineola, Long Island
*Nathan Littauer Hospital, Gloversville
New Rochelle Hospital, New Rochelle
Ossining Hospital, Ossining
Peoples Hospital, New York
Reconstruction Hospital, New York
Rome Hospital, Rome
St. Bartholomew's Hospital, New York
*St. Joseph's Hospital, Yonkers
St. Vincent's Hospital, West New Brighton
Saratoga Hospital, Saratoga Springs
*Swedish Hospital, Brooklyn
*White Plains Hospital, White Plains

NORTH CAROLINA

100 or more beds

*James Walker Memorial Hospital, Wilmington
*North Carolina Baptist Hospital, Winston Salem
*St. Leo's Hospital, Greensboro
Watts Hospital, Durham

50 to 100 beds

Atlantic Coast Lines R. R. Hospital, Rocky Mount
Charlotte Sanitarium, Charlotte
City Hospital, Winston-Salem
Highpoint Hospital, Highpoint
Highsmith Hospital, Fayetteville
*Long's Sanitarium, Statesville
*Mercy Hospital, Charlotte
Parkview Hospital, Rocky Mount
*Rex Hospital, Raleigh
Rutherfordton Hospital, Rutherfordton
Salisbury Hospital, Salisbury

NORTH DAKOTA

100 or more beds

Bismarck Evangelical Deaconess Hospital, Bismarck
Grand Forks Deaconess Hospital, Grand Forks
St. Alexius' Hospital, Bismarck
St. John's Hospital, Fargo
St. Luke's Hospital, Fargo

50 to 100 beds

*St. Joseph's Hospital, Minot
St. Michael's Hospital, Grand Forks

OHIO

100 or more beds

Aultman Hospital, Canton
Bethesda Hospital, Cincinnati
Christ Hospital, Cincinnati
Cincinnati General Hospital, Cincinnati
City Hospital of Akron, Akron
Cleveland City Hospital, Cleveland
Glenville Hospital, Cleveland
Good Samaritan Hospital, Cincinnati
*Good Samaritan Hospital, Zanesville
Grant Hospital, Columbus
Hawkes Hospital of Mt. Carmel, Columbus
Huron Road Hospital, Cleveland
Jewish Hospital, Cincinnati
Lakeside Hospital, Cleveland
Lima Hospital, Lima
Lucas County Hospital, Toledo
*Lutheran Hospital, Cleveland
Mercy Hospital, Canton
Mercy Hospital, Hamilton
Mercy Hospital, Toledo
Miami Valley Hospital, Dayton
Mt. Sinai Hospital, Cleveland
*Peoples Hospital, Akron
St. Alexis' Hospital, Cleveland
St. Ann's Infant Asylum and Hospital, Cleveland
St. Elizabeth's Hospital, Dayton
St. Elizabeth's Hospital, Youngstown
St. Francis' Hospital, Columbus
St. John's Hospital, Cleveland
*St. Joseph's Hospital, Lorain
St. Luke's Hospital, Cleveland
St. Mary's Hospital, Cincinnati
St. Rita's Hospital, Lima
St. Vincent's Hospital, Cleveland
St. Vincent's Hospital, Toledo
*Seton Hospital, Cincinnati
Springfield City Hospital, Springfield
Toledo Hospital, Toledo
University Homeopathic Hospital, Columbus
*White Cross Hospital, Columbus
*Woman's Hospital, Cleveland
Youngstown Hospital, Youngstown

50 to 100 beds

Alliance City Hospital, Alliance
Bellaire City Hospital, Bellaire
*Bethesda Hospital, Zanesville
Children's Hospital, Cincinnati
Children's Hospital, Columbus
Deaconess Hospital, Cincinnati
Flower Hospital, Toledo
Good Samaritan Hospital, Sandusky
Lakewood Hospital, Lakewood
Mary Day Nursery and Children's Hospital, Akron
Massillon City Hospital, Massillon
Maternity and Children's Hospital, Toledo
Maternity Hospital, Cleveland
*Memorial Hospital, Fremont
Mercy Hospital, Columbus
Newark City Hospital, Newark
Robinwood Hospital, Toledo
Salem Hospital, Salem
Schirrman Hospital, Portsmouth
Warren City Hospital, Warren

OKLAHOMA

100 or more beds

St. Anthony's Hospital, Oklahoma City
State University Hospital, Oklahoma City

50 to 100 beds

*El Reno Sanitarium, El Reno
*Wesley Hospital, Oklahoma City

OREGON

100 or more beds

Emmanuel Hospital, Portland
Good Samaritan Hospital, Portland
Multnomah County Hospital, Portland
St. Vincent's Hospital, Portland

50 to 100 beds

Portland Sanitarium, Portland
Portland Surgical Hospital, Portland
*Sacred Heart Hospital, Medford

PENNSYLVANIA

100 or more beds

Abingdon Memorial Hospital, Abingdon
Allegheny General Hospital, Pittsburgh
Allentown Hospital, Allentown
Altoona Hospital, Altoona
Braddock General Hospital, Braddock
Chester County Hospital, West Chester
*Chester Hospital, Chester
Chestnut Hill Hospital, Philadelphia
Children's Homeopathic Hospital, Philadelphia
Children's Hospital, Pittsburgh
Clearfield Hospital, Clearfield
Columbia Hospital, Pittsburgh
Conemaugh Valley Memorial Hospital, Johnstown
Easton Hospital, Easton
Elizabeth Steel Magee Hospital, Pittsburgh
Frankford Hospital, Philadelphia
George F. Geisinger Hospital, Danville
Germantown Dispensary and Hospital, Philadelphia
Hahnemann Hospital, Scranton
Hahnemann Medical and Surgical Hospital, Philadelphia
Hamot Hospital, Erie
Harrisburg Hospital, Harrisburg
Homeopathic Medical and Surgical Hospital, Pittsburgh
Hospital of the Protestant Episcopal Church, Philadelphia
Hospital of the University of Pennsylvania, Philadelphia
Hospital of the Women's Medical College, Philadelphia
*J. Lewis Crozer Home and Hospital, Chester
Jefferson Hospital, Philadelphia
Jewish Hospital, Philadelphia
*Kane Summitt Hospital, Kane
Lancaster General Hospital, Lancaster
Lankenau Hospital, Philadelphia
*McKeesport Hospital, McKeesport
Medico Chirurgical Hospital, Philadelphia
Memorial Hospital, Roxborough
Mercy Hospital, Johnstown
Mercy Hospital, Philadelphia
Mercy Hospital, Pittsburgh
Mercy Hospital, Wilkes-Barre
Methodist Episcopal Hospital, Philadelphia

Misericordia Hospital, Philadelphia
Moses Taylor Hospital, Scranton
Mt. Sinai Hospital, Philadelphia
Passavant Hospital, Pittsburgh
Pennsylvania Hospital, Philadelphia
Philadelphia General Hospital, Philadelphia
Philadelphia Polyclinic Hospital, Philadelphia
Pittsburgh Hospital, Pittsburgh
Pottsville Hospital, Pottsville
Presbyterian Hospital, Philadelphia
Presbyterian Hospital, Pittsburgh
Reading Hospital, Reading
Robert Packer Hospital, Sayre
Sacred Heart Hospital, Allentown
St. Agnes' Hospital, Philadelphia
St. Francis' Hospital, Pittsburgh
St. John's General Hospital, Pittsburgh
St. Joseph's Hospital, Lancaster
*St. Joseph's Hospital, Philadelphia
St. Joseph's Hospital, Pittsburgh
St. Joseph's Hospital, Reading
St. Luke's Hospital, South Bethlehem
St. Margaret's Hospital, Pittsburgh
St. Mary's Hospital, Philadelphia
St. Vincent's Hospital, Erie
Samaritan Hospital, Philadelphia
South Side Hospital, Pittsburgh
State Hospital for Injured Persons, Ashland
State Hospital of Middle Coal Fields, Hazelton
State Hospital of Northern Anthracite Region of Pennsylvania, Scranton
Uniontown Hospital, Uniontown
Washington Hospital, Washington
West Philadelphia Hospital for Women, Philadelphia
Western Pennsylvania Hospital, Pittsburgh
Wilkes-Barre City Hospital, Wilkes-Barre
*Williamsport Hospital, Williamsport
Wills Hospital, Philadelphia
Women's Homeopathic Hospital, Philadelphia
Women's Hospital, Philadelphia
York Hospital and Dispensary, York

50 to 100 beds

Annie M. Warner Hospital, Gettysburg
Bainbridge Private Hospital, Philadelphia
Bryn Mawr Hospital, Bryn Mawr
Carlisle Hospital, Carlisle
Children's Hospital, Philadelphia
Children's Hospital of Mary J. Drexel Home, Philadelphia
Citizens General Hospital, New Kensington
*Columbia Hospital, Columbia
Cottage State Hospital, Blossburg
*DuBois Hospital, DuBois
Good Samaritan Hospital, Lebanon
Howard Hospital, Philadelphia
*Homeopathic Hospital, West Chester
Indiana Hospital, Indiana
J. C. Blair Memorial Hospital, Huntington
*Jewish Maternity Hospital, Philadelphia
Kensington Hospital for Women, Philadelphia
Maple Avenue Hospital, DuBois
*Memorial Hospital of Monongahela, Monongahela
*Montefiore Hospital, Pittsburgh
*Ohio Valley Hospital, McKees Rock
Oil City Hospital, Oil City
Palmerton Hospital, Palmerton
Philadelphia Lying-in Charity Hospital, Philadelphia
*Pittston Hospital, Pittston
*Polyclinic Hospital, Harrisburg
Preston Retreat Hospital, Philadelphia
*Providence Hospital, Beaver Falls
St. Luke's Homeopathic Hospital, Philadelphia
St. Vincent's Hospital for Women and Children, Philadelphia
*Sewickley Hospital, Sewickley
*State Hospital of Nanticoke, Nanticoke
*Stetson Hospital, Philadelphia
Suburban General Hospital, Bellevue
Windber Hospital, Windber

RHODE ISLAND

100 or more beds

Newport Hospital, Newport
Rhode Island Hospital, Providence
St. Joseph's Hospital, Providence

50 to 100 beds

Memorial Hospital, Pawtucket
Providence Lying-in Hospital, Providence

SOUTH CAROLINA

100 or more beds

Columbia Hospital, Columbia
Florence Infirmary, Florence
Greenville City Hospital, Greenville
Roper Hospital, Charleston
South Carolina Baptist Hospital, Columbia

50 to 100 beds

Anderson County Hospital, Anderson
Baker Sanatorium, Charleston
St. Francis Xavier Infirmary, Charleston
*University Hospital, Anderson

SOUTH DAKOTA

100 or more beds

McKennan Hospital, Sioux Falls
*Sacred Heart Hospital, Yankton
St. Luke's Hospital, Aberdeen

50 to 100 beds

Bartron Hospital, Watertown
Lincoln Hospital, Aberdeen
Luther Hospital, Watertown
*Moe Hospital, Sioux Falls
New Madison Hospital, Madison
Methodist State Hospital, Mitchell
*Peabody Hospital, Webster
*St. Joseph's Hospital, Deadwood
*St. Joseph's Hospital, Mitchell
St. Mary's Hospital, Pierre

TENNESSEE

100 or more beds

Baptist Hospital, Memphis
Erlanger Hospital, Chattanooga
George W. Hubbard Hospital, Nashville
Knoxville General Hospital, Knoxville
Memphis General Hospital, Memphis
Nashville City Hospital, Nashville
St. Joseph's Hospital, Memphis
St. Thomas Hospital, Nashville
Vanderbilt Hospital, Nashville

50 to 100 beds

Baird-Dulaney Hospital, Dyersburg
*Fort Sanders Hospital, Knoxville
Lucy Brinkley Hospital, Memphis
Newell and Newell Sanitarium, Chattanooga
*Protestant Hospital, Nashville
*Riverside Hospital, Knoxville
Woman's Hospital of State of Tennessee, Nashville

TEXAS

100 or more beds

Baptist Hospital, Houston
Baylor Hospital, Dallas
Central Texas Baptist Sanitarium, Waco
Hotel Dieu, Beaumont
John Sealy Hospital, Galveston
Parkland Hospital, Dallas
Providence Hospital, Waco
St. Joseph's Infirmary, Ft. Worth
St. Joseph's Infirmary, Houston
St. Mary's Infirmary, Galveston
St. Paul's Sanitarium, Dallas
Santa Fe Hospital, Temple
Santa Rosa Infirmary, San Antonio
Scott and White Sanitarium, Temple
Seton Infirmary, Austin
Southern Pacific Hospital, Houston

50 to 100 beds

All Saints' Hospital, Ft. Worth
*City and County Hospital, Houston
*Frances Ann Lutcher Hospital, Orange
Harris Sanitarium, Ft. Worth
International and Great Northern R. R. Hospital, Palestine
King's Daughters' Hospital, Temple
*Masonic Hospital, El Paso
*St. Joseph's Infirmary, Paris
*Texarkana Sanitarium, Texarkana

UTAH

100 or more beds

Doctor W. H. Groves Latter Day Saints' Hospital, Salt Lake City
Holy Cross Hospital, Salt Lake City
St. Mark's Hospital, Salt Lake City
Salt Lake County Hospital, Salt Lake City
Thomas D. Dee Memorial Hospital, Ogden

50 to 100 beds

Utah-Idaho Hospital, Logan

VERMONT

100 or more beds

Mary Fletcher Hospital, Burlington

50 to 100 beds

Fanny Allen Hospital, Winooski
Heaton Hospital, Montpelier
Rutland Hospital, Rutland
*St. Albans Hospital, St. Albans

VIRGINIA

100 or more beds

Chesapeake and Ohio R. R. Hospital, Clifton Forge
*Hospital Division of Medical College of Virginia, Richmond
Norfolk Protestant Hospital, Norfolk
St. Vincent's Hospital, Norfolk
Stuart Circle Hospital, Richmond
University of Virginia Hospital, Charlottesville

50 to 100 beds

Elizabeth Buxton Hospital, Newport News
George Ben Johnson Memorial Hospital, Abington
*Grace Hospital, Richmond
Jefferson Hospital, Roanoke
Johnston-Willis Sanitarium, Richmond
King's Daughters' Hospital, Staunton
Lake View Hospital, Suffolk
Lewis Gale Hospital, Roanoke
*Parrish Memorial Hospital, Portsmouth
St. Elizabeth's Hospital, Richmond
St. Luke's Hospital, Richmond
Sarah Leigh Hospital, Norfolk

WASHINGTON

100 or more beds

Children's Orthopedic Hospital, Seattle
Columbus Sanitarium, Seattle
King County Hospital, Seattle
Maria Beard Deaconess Hospital, Spokane
*Northern Pacific Hospital, Tacoma
Providence Hospital, Seattle
Sacred Heart Hospital, Spokane
St. Elizabeth's Hospital, Yakima
St. Joseph's Hospital, Tacoma
St. Luke's Hospital, Spokane
St. Mary's Hospital, Walla Walla
Seattle City Hospital, Seattle
Seattle General Hospital, Seattle
Swedish Hospital, Seattle
Tacoma General Hospital, Tacoma

50 to 100 beds

Minor Private Hospital, Seattle
*St. Joseph's Hospital, Bellingham
St. Luke's Hospital, Seattle
Virginia Mason Hospital, Seattle

WEST VIRGINIA

100 or more beds

Charleston General Hospital, Charleston
Kessler Hatfield Hospital, Huntington
Ohio Valley Hospital, Wheeling
St. Mary's Hospital, Clarksburg
Welch Hospital, No. 1, Welch
Wheeling Hospital, Wheeling

50 to 100 beds

*Beckley Hospital, Beckley
Bluefield Sanitarium, Bluefield
Coal Valley Hospital, Montgomery
Cook Hospital, Fairmont
Davis Memorial Hospital, Elkins
Guthrie Hospital, Huntington
McKendree Hospital, No. 2, McKendree

WISCONSIN

100 or more beds

LaCrosse Lutheran Hospital, LaCrosse
Luther Hospital, Eau Claire
Madison General Hospital, Madison
Mercy Hospital, Janesville
Milwaukee County Hospital, Milwaukee

Milwaukee Hospital, Milwaukee
Mt. Sinai Hospital, Milwaukee
St. Agnes' Hospital, Fond du Lac
St. Elizabeth's Hospital, Appleton
St. Francis Hospital, LaCrosse
St. Joseph's Hospital, Marshfield
St. Joseph's Hospital, Milwaukee
*St. Mary's Hospital, Green Bay
St. Mary's and Mercy Hospital, Oshkosh
St. Mary's Hospital, Milwaukee
St. Mary's Hospital, Superior
Trinity Hospital, Milwaukee

50 to 100 beds

*Columbia Hospital, Milwaukee
Evangelical Deaconess Hospital, Milwaukee
Grandview Hospital, LaCrosse
*Hanover General Hospital, Milwaukee
*Holy Family Hospital, Manitowoc
*LaCrosse Public Hospital, LaCrosse
Milwaukee Children's Hospital, Milwaukee
*Milwaukee Maternity and General Hospital, Milwaukee
Misericordia Hospital, Milwaukee
St. Joseph's Hospital, Dodgeville
*St. Luke's Hospital, Racine
St. Mary's Hospital, Madison
St. Mary's Hospital, Racine

WYOMING

50 to 100 beds

*Casper Private Hospital, Casper
Wheatland Hospital, Wheatland

CANADA

ALBERTA

100 or more beds

General Hospital, Calgary
Edmonton General Hospital, Edmonton
Holy Cross Hospital, Calgary
Medicine Hat Hospital, Medicine Hat
Misericordia Hospital, Edmonton
Royal Alexandra Hospital, Edmonton
University of Alberta Hospital, Edmonton

50 to 100 beds

Lamont Public Hospital, Lamont
*Galt Hospital, Lethbridge

BRITISH COLUMBIA

100 or more beds

Provincial Royal Jubilee Hospital, Victoria
Royal Columbian Hospital, New Westminster
Royal Inland Hospital, Kamloops
St. Joseph's Hospital, Victoria
St. Paul's Hospital, Vancouver
Vancouver General Hospital, Vancouver

50 to 100 beds

*Queen Victoria Hospital, Revelstoke
*St. Eugene Hospital, Cranbrook
*St. Mary's Hospital, New Westminister
*Vernon Jubilee Hospital, Vernon

MANITOBA

100 or more beds

Brandon General Hospital, Brandon
Children's Hospital, Winnipeg
Grace Hospital, Winnipeg
Misericordia Hospital, Winnipeg
St. Boniface's Hospital, St. Boniface
Winnipeg General Hospital, Winnipeg

50 to 100 beds

Victoria Hospital, Winnipeg

NEW BRUNSWICK

100 or more beds

General Public Hospital St. John

50 to 100 beds

Chipman Memorial Hospital, St. Stephen
Hotel Dieu, Campbellton
Hotel Dieu, Chatham
Miramichi Hospital, New Castle
Moncton Hospital, Moncton
St. John's Infirmary, St. John
Restigouche and Bay of Chaleur Soldiers' Memorial Hospital, Campbellton
*Victoria Public Hospital, Fredericton

NOVA SCOTIA

100 or more beds

St. Joseph's Hospital, Glace Bay
Salvation Army Hospital, Halifax
Victoria General Hospital, Halifax

50 to 100 beds

*Aberdeen Hospital, New Glasgow
Children's Hospital, Halifax
General Hospital, Glace Bay
Halifax Infirmary, Halifax
Highland View Hospital, Amherst
St. Martha's Hospital, Antigonish
*Sydney City Hospital Sydney
*Yarmouth Hospital, Yarmouth

ONTARIO

100 or more beds

General Hospital, Kingston
Grace Hospital, Toronto
Hamilton General Hospital, Hamilton
Hotel Dieu, Kingston
McKellar General Hospital, Ft. William
Ottawa General Hospital, Ottawa
Protestant General Hospital, Ottawa
St. Joseph's Hospital, Hamilton
*St. Joseph's Hospital, London
St. Joseph's Hospital, Sudbury
St. Luke's Hospital, Ottawa
St. Michael's Hospital, Toronto
Sick Children's Hospital, Toronto
Toronto General Hospital, Toronto
Western Hospital, Toronto
Victoria Hospital, London

50 to 100 beds

*General Hospital, Brockville
General Hospital, Sault Ste. Marie

Nicholls Hospital, Peterboro
Oshawa Memorial Hospital, Oshawa
*Owen Sound General and Marine Hospital, Owen Sound
*Public Hospital, Smith Falls
*St. Francis' Hospital, Smith Falls
St. Joseph's Hospital, Peterboro
St. Vincent de Paul Hospital, Brockville
Welland County Hospital, Welland
Wellesley Hospital, Toronto
Women's College Hospital, Toronto

PRINCE EDWARD ISLAND

50 to 100 beds

Charlottetown Hospital, Charlottetown
*Prince County Hospital, Summerside
Prince Edward Island Hospital, Charlottetown

QUEBEC

100 or more beds

Children's Memorial Hospital, Montreal
General St. Vincent Hospital, Sherbrooke
Hotel Dieu, Montreal
Jeffery Hale's Hospital, Quebec
Montreal General Hospital, Montreal
Notre Dame Hospital, Montreal
Sainte Justine Pour Les Enfants, Montreal
Royal Victoria Hospital, Montreal
Western Hospital, Montreal

50 to 100 beds

Montreal Maternity Hospital, Montreal
St. Francois d'Assise, Quebec
*Sherbrooke Hospital, Sherbrooke

SASKATCHEWAN

100 or more beds

Grey Nuns Hospital, Regina
Providence Hospital, Moose Jaw
St. Paul's Hospital, Saskatoon
*Saskatoon City Hospital, Saskatoon

50 to 100 beds

Holy Family Hospital, Prince Albert
Notre Dame Hospital, North Battleford
*Moose Jaw General Hospital, Moose Jaw
*Victoria Hospital, Prince Albert